THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LIV. No. 1390.] LONDON, DECEMBER 31, 1889. [41ST YEAR. Price 6d.

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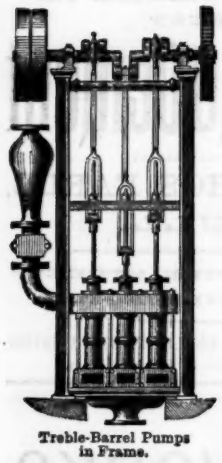

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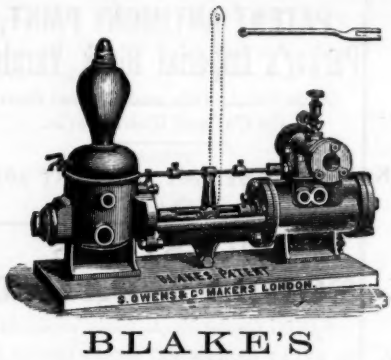

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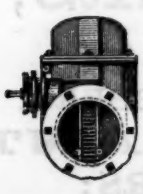

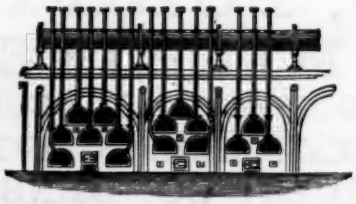

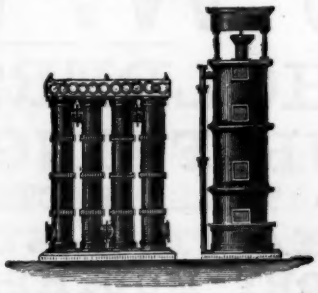

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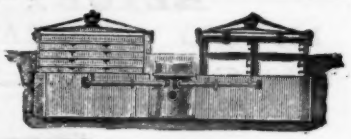

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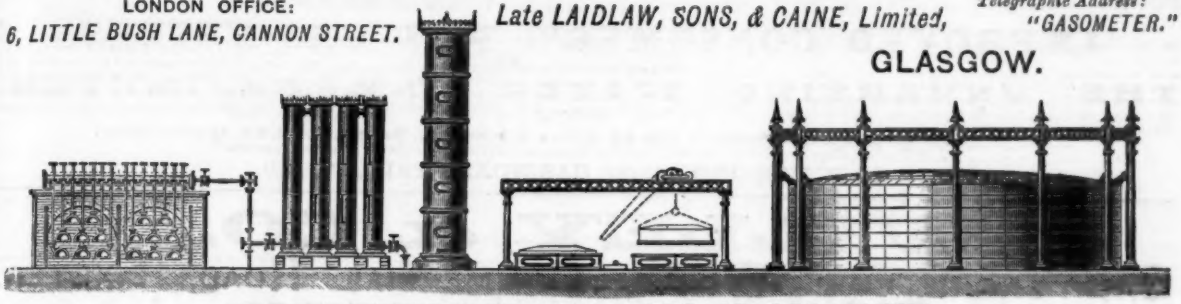

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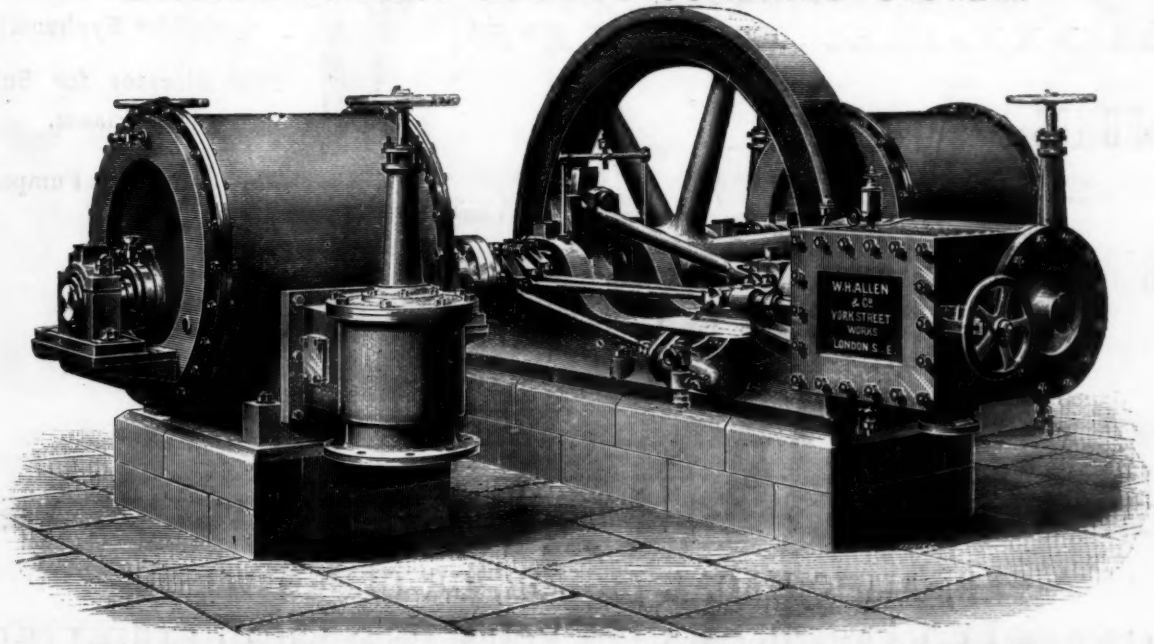

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Further particulars may be had on application to A. F. Wilson, Esq., Assoc. M. Inst. C.E., 12, Walbrook, London, E.C., Agent for London; J. E. Fisher, Esq., Stourbridge, Agent for the rest of England, Wales, and Ireland; or to the Patentee—

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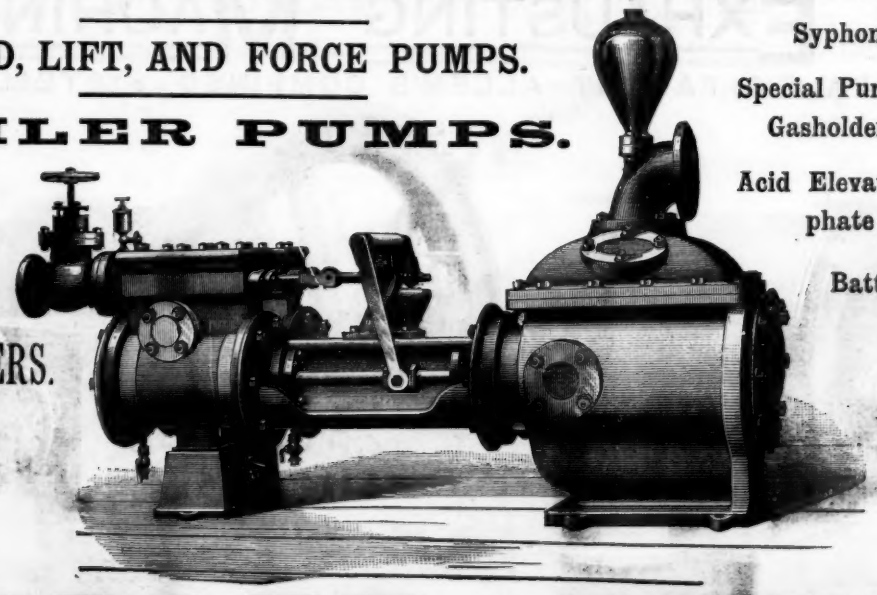

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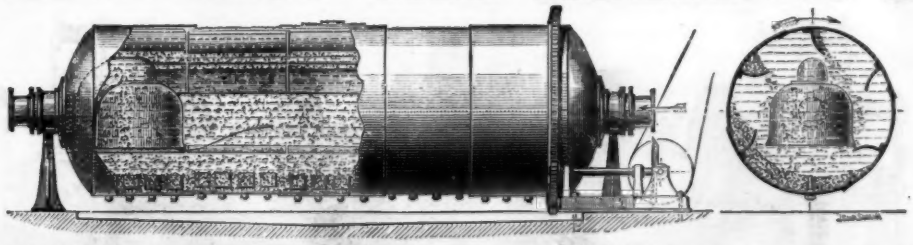

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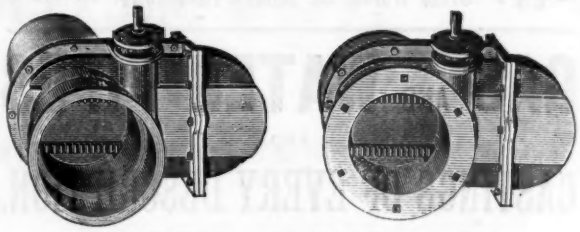

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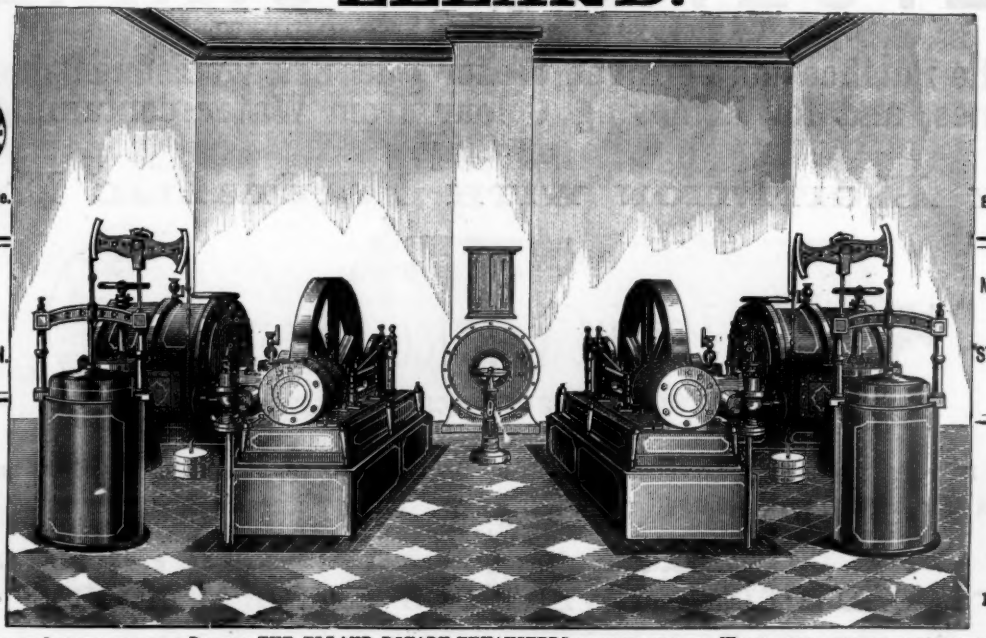

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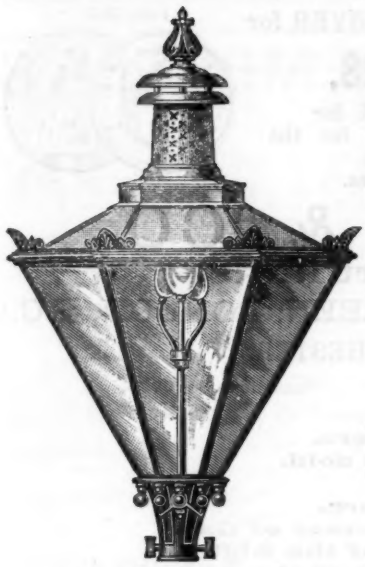

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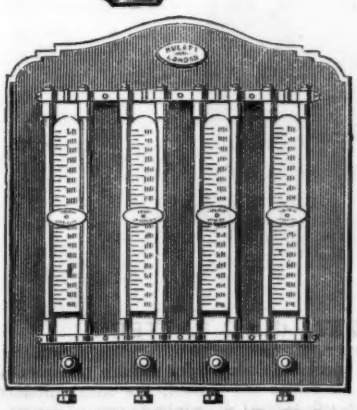

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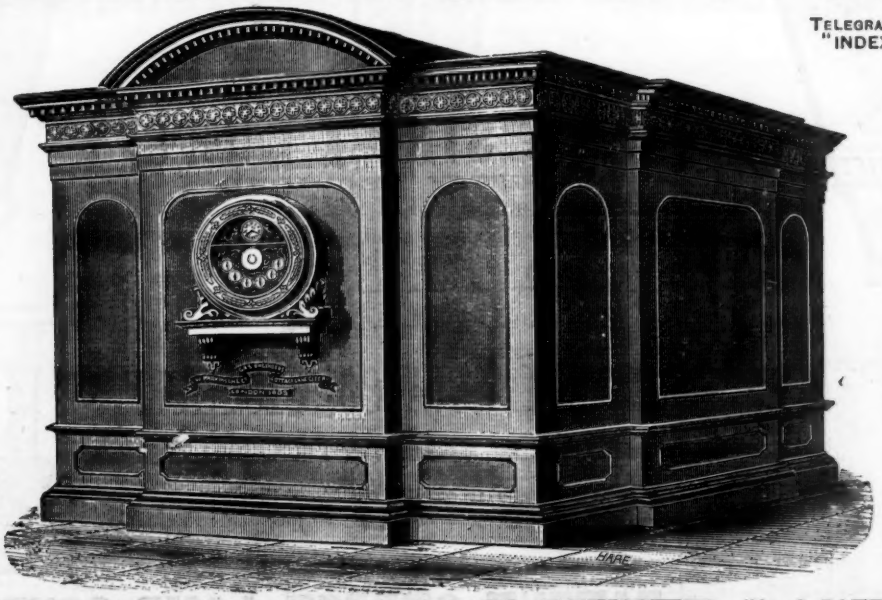

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[See also Advt., p. 1272.

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THE JOURNAL OF GAS LIGHTING,
WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, DECEMBER 31, 1889.

1889.

A RETROSPECT OF THE YEAR.

THE year that ends to-day deserves to be regarded in retrospect for several reasons. Of course, the same may be said of every year; and the longer we live, the more momentous do the years appear. Whether as young men, with aspirations yet unsatisfied, we experience a chill as the thought strikes us of another year slipped by, leaving us still stranded among the unappreciated, or as seniors we feel our grasp upon the affairs of our age weakening with the passage of unhasting and unresting time, the close of the year is an event that compels reflection. It is impossible to say at the moment of its close whether one year or another has been the more significant and memorable. Individual experience varies so irreconcileably, that a year of stagnation for one person may be remembered as full of important events for another. Yet years differ in their records for groups of individuals, societies, and industries in ways more susceptible of general statement than is possible in regard to personal experiences. So it is that we are able to characterize in general terms the year that now expires as a memorable one for the gas industry, both in respect of the external influences and the internal developments that have affected it during the period in question. The general revival of trade and increased liveliness of commercial speculation, the recrudescence of the rivalry of electric lighting, the labour troubles in gas-works, are enough to mark the year 1889 as exceptional in the recollections of British Gas Engineers; to say nothing of the minor but yet memorable features of the time that must occupy in their degree the attention of the historian. In regard to the expansion of trade, it is, as usual, impossible to explain the fact, which can only be recorded. The year 1889 is acknowledged by most manufacturers and traders as one of the best that has come within their recent experience; although, as every good has its qualifying evils, the activity of trade has been attended by troublesome combinations of capitalists in the early part and of workmen in the latter part of the year. It is a remarkable fact that although most British employers and workmen, if questioned on the subject, would profess acquiescence in the commercial principles and rules under which this country has attained its present condition—that is to say, they are all Free Traders, believers in the efficacy of competition, and so forth—yet both parties are prone to attempt to snatch peculiar advantages by means of combinations and plots which, if not exactly illegal, are too selfish to bear inclusion within the most selfish economic theory. The more recent labour troubles of the autumn and winter have driven into the background the syndicates of producers and manufacturers, rumours of which troubled the community in the spring and early summer; but it is only necessary to recall the Copper Ring, the Salt Union, and the threatened combinations of fire-clay and coal owners, to prove the assertion that selfish plotting is not a peculiarity of one order in the trading community. The law of exchange values is too powerful, however, for rebels, whether capitalists or labourers. Commodities are dear or cheap, labour is well or poorly paid, according to the operation of conditions that can only be affected in the most temporary and insignificant degrees by deliberate combinations of capitalists or of wage-earners. Take the example of the Salt Union, which was formed to raise the value of Cheshire salt. The immediate effect was to open a market that had previously been closed to the product of Spain, and to present the world with the curious spectacle of ships unloading salt from Cadiz in British ports. The rise in the value of coal, iron, and freights that set in about the middle of the year—the former considerable enough to neutralize for the district concerned the effect expected from the partial removal of the London Coal Dues—is an example of a natural, as compared with an artificial improvement.

A time of expansion in values is not of unmixed benefit for the gas industry; for coal and iron must be had whatever their cost, while the selling price of gas remains stationary, and residuals are only partially affected. Coke has sold well throughout the year; and tar improved in value. The sulphate market showed little change. Regarded as an investment, it cannot be said that gas stocks have quite maintained their position, although they are not so low now as at one time appeared possible. It is open for argument whether a depression in gas stock which marked the autumn, may be ascribed to the anticipated commencement of business by the great Metropolitan Electric Light Companies which were so well advertized during the summer. It may have been thought that these ventures could not find users for the millions of lights which they were preparing to supply, except by making a serious inroad upon the Gas Companies' preserves. If electricity was pushing to the fore, petroleum decidedly lagged in the rear. Complaints of deterioration of quality were rife as regards the American product, while difficulties in respect of the proposed pipe-line postponed for a time the promised flooding of the world with Russian oil. On the whole, the repute of coal gas as the principal illuminant for towns was well maintained, especially as a consequence of the fear entertained in the winter lest workmen's plots should have the effect of depriving the community of their supply. Many people never found gas so precious as when brought face to face with the possibility of losing it.

This remark brings us to the subject of the labour troubles that have marked the year in the memories of most

gas managers. It is impossible to give here a full account of the strike of the London dock labourers, or the consequent gas stokers' agitation for shorter working time and increased pay, which originated in London and spread like wildfire over the whole country. Pages of the JOURNAL have been occupied week after week with records of the movement, of which we can only summarize the course and results. It began in the spring, among the stokers at Beckton, who formed a Trade Union under the leadership of two of their body—men named Thorne and Hutchins. The reduction of the usual London working shift of twelve hours to eight, with a corresponding lightening of the work, and double pay for Sunday labour were the first demands made by the Union men of their employers. The movement was almost simultaneous in all the London gas-works; and eventually, with more or less modification, the eight-hour shifts were conceded. At one of the first meetings Thorne, who was the chief organizer of the so-called National Union, said that when they felt strong enough they should also demand another shilling a day. For the moment, however, nothing was said of this or of any other object of the Union beyond reducing the labour of the stokers, which was represented as killing the men. An independent Union was formed among the men employed by the Bristol United Gas Company, and soon came to open rupture with the employers on a question of work and wages. The men sent in their notices in the first week of October, and the Directors accepted them. It was essentially a dispute over terms, and ought never to have been allowed to go to the extremity of a strike. The Directors of the Company were very badly advised in this affair, however; and their whole business was mismanaged, with the result that the men won. The event was most unfortunate, as giving gas stokers everywhere to believe themselves invincible and indispensable. Locally, the manufacturers and traders of Bristol have since been plagued on all sides with labour troubles traceable to the gas workers' example. The next prominent scene of action in the movement was Manchester, where, as in other places, the stereotyped demands for the eight-hour shift and increased pay for overtime and Sunday work were conceded at the end of October, to the expressed satisfaction of the men. Less than a month later, the men in the employ of the Manchester Corporation Gas Department formulated further demands, among which was one for the dismissal of all non-Unionists. In reply to this communication of Union views, the Manchester Gas Committee issued the declaration "that "every man who faithfully does his duty, and the work for "which he is paid—so long as his services are required by "the Gas Committee—shall have perfect freedom to con-"tinue his employment, and shall be protected in the dis-"charge of his duties." The men thereupon sent in their notices, and were supported "out of sympathy" by the Union stokers in the employ of the Salford Corporation. The Corporations of Manchester and Salford adhered firmly to their determination not to become the tools of Trade Union tyranny, and a strike followed. The two towns suffered severely from insufficient supply of gas for many days; but eventually the strikers were obliged to confess themselves beaten, and realized too late their fatuity in throwing up good places at the instigation of Union officials who had completely miscalculated their powers of offence. The repudiation of the misguided strikers by the Executive of the National Union, who declared themselves unable to afford the victims anything more than "moral "support," completed the tragic farce of the Manchester and Salford gas workers' insurrection. Meanwhile, an even more interesting incident was being developed in London. The severance between employers and employed was becoming more marked every day of the existence of the Union. Mass meetings of Unionists were of almost weekly occurrence—at first ostensibly to celebrate the triumph of the Union organization, and then to denounce all workmen who had not joined, or were suspected of lack of docility to, the Union leaders. Relations between masters and men became very strained, particularly at the South Metropolitan works, where the Directors showed reluctance to abdicate control of the men in favour of demagogues, mostly complete strangers to the service, the President and General Secretary of the Union being Beckton men, and those members of the Union Executive hailing from South Metropolitan stations who made most noise being winter hands, or otherwise only casually connected with the Company. Twice the Union hands (comprising nearly all the stokers) sent in their notices; and each time they gained their point—the Company not being prepared to resist. The programme of the Union leaders, although never formulated in precise terms, was up to Nov. 11 substantially as follows:—First, the eight-hour shift and double time for Sunday work; second, expulsion from the works of all non-Union men; third, a general advance of wages. What more they may have had in contemplation will probably never be known, for on the date already named, Mr. George Livesey, Chairman of the South Metropolitan Company, sent to the JOURNAL the announcement of a scheme adopted by the Board of the Company on the previous Wednesday, whereby workmen who would sign a yearly agreement to serve the Company should participate in the profits of the undertaking according to the terms of a sliding scale, based on the selling price of gas. The workman's share was to be 1 per cent. on the amount of his year's wages for every penny reduction below 2s. 8d. per 1000 cubic feet. This would be actually 5 per cent. for the current year; the price of gas being 2s. 3d. per 1000 cubic feet. Then, in order to give the scheme a fair start, it was dated back three years. This would have the effect of giving every man a "nest-egg" of several pounds, on which, as on the yearly additions, the Company promised to pay 4 per cent. compound interest. It was confessedly an attempt to identify the interest of the men with that of the Company; Mr. Livesey's idea being to apply in this way a portion of the money which he foresaw might otherwise be required for meeting a strike. The scheme received the approbation of the respectable portion of the press and the reflecting public, and was adopted by about 1000 men in the Company's employ. The majority of the stokers, however, held aloof from it by order of the Union leaders, while meetings and negotiations respecting it went on for several weeks. By the beginning of December the Union Executive had made up their minds to oppose the Directors' scheme; and at a mass meeting held at Deptford Mr. Thorne promised his supporters that if they would only stand by the Union "they would get the bonus without waiting a year"—in allusion, probably, to the notion of employing the strength of the organization to enforce an advance of wages after all non-Unionists had been got rid of. A few days later the Union Executive plucked up heart for a declaration of war; and on Dec. 5 all the Union men in the Company's employ handed in their notices to quit work unless the Directors forthwith consented to abandon the profit-sharing scheme, and to dismiss every man who had accepted it. This was the climax. The Union leaders saw that they must either crush the South Metropolitan Directors and their loyal hands, or be themselves crushed. The Directors were, however, ready for all emergencies. Foreseeing the possibility of a strike at any moment if they should resist the most extravagant Union demand, the Board and their officers had made all necessary preparations for the event. Mr. Frank Livesey's dispositions were so complete that when the moment for action came he had only to set in operation a plan of campaign that had been elaborated in every detail weeks before. The police were warned betimes; and the strikers, who had evidently calculated upon ability to set up a Reign of Darkness and Terror in South London as a means towards gaining their ends, were out-generalled, overawed, and disheartened from the start. Fresh men were imported to fill their places; and notwithstanding a futile attempt on the part of the Union leaders to stop supplies of coal from reaching the works, the emergency was met without sensible inconvenience to the consumers. During the last days of the year, the Union men at Norwich made a demand for the dismissal of all non-unionists; but seeing that the British Gas Company were prepared to resist, and probably learning prudence from the fate of the London men, they withdrew their demand at the last moment. The South Metropolitan and Manchester and Salford gas strikes, full and special accounts of which have been published in the JOURNAL, are to be ranked as the events of the year for the British industry of gas supply, whether we have regard to the magnitude of the interests involved, the disturbance of business, or the importance of the lessons to be drawn from these extraordinary incidents.

In the parliamentary record relating to gas supply which we have kept as usual for the past year, there is little requiring recapitulation. The most important feature is the proceedings with regard to the West Ham Company's Act, which may be styled the comment of Parliament on the Ashton case; being the first attempt to make the operation of the sliding scale compulsory. The Act is, in short, an important precedent not to be neglected by students of contemporary gas legislation. The partial lapse of the London Coal Dues was an important event in connection with the gas

supply of the Metropolis; and the statutory readjustment of railway rates under the Railway and Canal Traffic Act threatened to have a serious effect upon the cost of railway-borne gas coals. A Committee, representative of Gas Companies and Corporations owning gas undertakings, was formed upon the initiation of Mr. J. Deakes, of Worcester, to watch over the gas interest in this matter. The publication of the Board of Trade returns relating to statutory gas supply in the United Kingdom was made the occasion of some damaging criticism in our pages, in which the accuracy of these statistics was gravely questioned. The proceedings of the London Electric Light Companies gave the Gas Companies some little anxiety with regard to their mains. A suggestion from the Board of Trade for the legalization of a standard of light other than the candle for photometrical purposes came to nothing for want of agreement among the parties interested in the change. The summary extinction of the Metropolitan Board of Works, and the coming into existence of the London County Council, under the Local Government Act, 1888, were events of much importance in the history of the statutory control of the gas supply of the Metropolis. There were no fresh transfers of gas undertakings to local authorities. The Corporation gas supply of Edinburgh and Leith came into practical working order; but a proposal for the transfer of the Bournemouth Gas-Works was rejected by the vote of the ratepayers.

The most remarkable law case affecting gas supply that comes into the year's history is the action of The Gaslight and Coke Company against the South Metropolitan Gas Company respecting the partition of the Nine Elms goods yard of the London and South-Western Railway Company with reference to the statutory provisions under which the London Gas Companies are confined to particular districts. The point in this instance was narrowed down at last to the question whether Gas Companies are compelled to have regard to the destination of their gas after it passes the consumer's meter. After securing victories in the lower Courts, the South Metropolitan Company lost the day in the House of Lords; and it must now be held, on the judgment of the highest tribunal, that gas supply extends to delivery at the burner —measurement by the meter being merely incidental to the transaction. A very peculiar example of litigation was that of the Alliance and Dublin Consumers' Gas Company against the Corporation of Dublin for the amount due for lighting the public lamps, which was withheld by the Corporation on the pretence that the Company had made default in various ways in carrying out their part of the bargain. The suit ended in an arbitration to settle the matters in dispute between the parties; and this in turn came to nothing, owing to the adversaries agreeing to terms for a settlement out of Court. A matter that very seriously troubled the London Gas Companies during the year was the Police Court prosecutions for deficiencies of illuminating power to which they were subjected by the County Council. The trouble appears to have arisen out of discrepancies among the readings of different photometers experimented with by the Referees; and, unfortunately, there is small prospect of the speedy removal of this source of annoyance and loss to the Companies.

A fair number of new processes and inventions in connection with gas making have attracted public attention during the past year. There has been a distinct revival of speculation in new or ostensibly novel descriptions of illuminating and fuel gas. To say little of such devices as the Lawrence Automatic gas, which is simply common gas carburetted with petroleum spirit, or the Lothammer gas, which is air carburetted under pressure with the same material, notice must be taken of the remarkable "boom" in water gas, which was secured by the clever financial operations of the promoters of the British Water Gas Syndicate. The £5 shares of this venture, £3 paid, were at one time forced up to £26; and two concessionary Companies were launched before the bubble collapsed. The question of the possibility of utilizing water-gas plant as an auxiliary to the coal-gas plant in British gas-works, previously regarded as impracticable on the score of expense of production, was seriously raised towards the close of the year, when the Directors of The Gaslight and Coke Company sent their Chief Engineer (Mr. G. C. Trewby) to the United States to inquire into this and other matters of which American gas engineers have special knowledge. Several American engineers of experience in water-gas manufacture came to this country about the same time, with a view to demonstrating the practicability of making carburetted water gas here at a cost comparable with that of ordinary coal gas. It was reported that at least two, and perhaps more, of the London Gas Companies contemplated putting these claims to the proof of experiment on a considerable scale; and a working water-gas plant has actually been erected by the Van Steenbergh Syndicate at Humphrey's Hall, Knightsbridge. Meanwhile, pressing labour troubles caused attention to be given in increased measure to devices for reducing the handiwork of coal-gas manufacture. Favourable notice was taken of the inclined retort-settings of M. Coze, of Rheims, the successful working of which with English caking coal was proved to the satisfaction of a deputation of representative English engineers who visited Rheims for the purpose. M. Coze's success has already attracted a host of imitators, with whom he will probably have to fight for his profits if his system, or anything like it, should be generally adopted. The Dinsmore process of improving coal gas by carbonizing the tar has been partially adopted at Widnes, and is being experimented with in some other places. Mr. Valon, at Ramsgate, has developed a process for the production and use of pure oxygen in gas purification, by an ingenious modification of the Brin process for separating oxygen from the atmosphere. The Claus system of continuous gas purification by liquids in closed vessels was adopted at the Belfast Gas-Works, and used successfully for 72 days, when there was a complete breakdown of the pumps attached to the apparatus, which proved to be of an unsuitable pattern. The capability of the plant, when in proper order, and the reliability of the system for dealing with a daily make of 1,600,000 cubic feet of gas, were, however, established; and the apparatus is to be shortly started again with new pumps. The interesting problem of dispensing, wholly or in part, with the lofty guide-framing of gasholders received further elucidation from the continued success of the Rotherhithe experiment, in which a triple-lift holder has framing only to the height of the second lift. The example was followed in designs for enlarging several other holders belonging to the South Metropolitan Company. Mr. W. Gadd, of Manchester, brought out a patented invention for guiding gasholders from the base, which was to be tried on a holder, not yet finished, at Northwich. Mr. E. Lloyd Pease, of the firm of Messrs. Ashmore, Benson, Pease, and Co., of Stockton, patented a system of rope guiding for gasholders, which was tried with success on a holder at Haslingden. No noteworthy advance was made in gas-burner construction; on the other hand, the idea of gas lighting by incandescence received a serious check through industrial and financial difficulties having overtaken the Incandescent Gas-Light Company, the owners for this country of the Welsbach patents.

In the early part of the year, before troubles in the works made gas managers concentrate their cares at home, a disposition was apparent in several places to take active steps for extending the use of gas among the different orders of householders who are not consumers. It was perceived that this could only be done by the manufacturers of gas consenting to do more than has hitherto been thought necessary by way of assisting consumers in the matter of internal fittings, the first cost of which is an acknowledged obstacle to tenants. The progress of this movement was checked in some places where it might have been expected to have assumed the fullest possible volume—in towns where the gas undertaking is public property—owing to fears of interfering with the vested rights of ironmongers and gasfitters, with votes of their own; but in several towns, noticeably at Ramsgate, where a most liberal scheme was adopted by the Corporation on the advice of Mr. Valon, the idea was carried out with encouraging results.

The year's record of The Gas Institute is a chequered one. It began badly with the further crumbling away of an already shattered Council, and the promulgation by the remaining minority, who were just numerous enough to form a quorum, of a policy on which they proposed to hold the organization together until the ordinary meeting in June. The minority then became the majority, able to do what they pleased with the machinery of the Institute. The President (Mr. H. Woodall) and the Secretary (Mr. W. H. Bennett) having retired, the senior member of the Council remaining—Mr. George Garnett, of Ryde—and Mr. W. Longworth, of Guildford, were chosen by their colleagues to act respectively as President and Honorary Secretary *pro tem.* These appointments were subsequently confirmed by the members at the general meeting; and Mr. Longworth was rewarded by a present of 100 guineas for his interim services to the Institute. One of the "planks," as an American politician would say, of the platform of the Garnett group was

the relegation of the trading members of the Institute—the manufacturers of gas apparatus, coal-owners, &c.—to a subordinate rank, without vote or voice in the management of the Institute in which they had enjoyed full membership. The idea underlying this proposal was to purge the Institute of the acknowledged evils that had culminated, in the course of 1888, in the withdrawal from it of most of the recognized leaders of the profession which it was supposed to represent. The annual meeting came round in due course; and the place of assembly having been changed from Brighton to London, there was a fair attendance of members, who so far approved of the action of the minority of the Council in keeping the Institute together as to confirm them in their offices, which they retained, however, at the price of the postponement, for consideration by the reconstituted and reinforced Council, of their chief project of reform with reference to the trading members. The technical transactions of the meeting were not up to the usual standard; and a visit paid subsequently, in the name of the Institute, to the Paris Exhibition, when the French Society of Gas Managers returned the hospitality they had experienced during their trip to England the year before, was very distinctly of the nature of a "maimed rite." The New Council undertook the task, which had proved too heavy for their immediate predecessors, of reforming the Institute; but up to the present time little or nothing has been done besides advertising for a Secretary, with, it is rumoured, not very promising results.

Meanwhile the retiring members of The Gas Institute, and others who had not recognized its sufficiency as an embodiment of the personality of the gas engineering profession, met with a view to the formation of a Society in the constitution and proceedings of which the errors revealed by experience of the working of the Institute might be avoided. A Provisional Committee, with Mr. A. Colson, of Leicester, as Honorary Secretary, was formed; and an influential meeting was held in June—Mr. W. Foulis, of Glasgow, in the chair—at which the establishment of a new Association of Gas Engineers was considered. In view of the recently expressed desire of Mr. Garnett, President, Mr. J. Hepworth, Senior Vice-President, and other influential members of The Gas Institute, which had terminated its meetings on the previous day, for a healing of the breach between the old and new organizations, it was decided to wait for events before taking the irretrievable step of founding a new Society. Two meetings have since been held, however—one of the Council of the Institute, and the other of the Provisional Committee of the new organization—without any apparent *rapprochement;* and it is now only too probable that the division in the ranks of the profession will appear in the shape of two technical societies.

The various District Associations of Gas Managers have gained from the troubles of the central Institute; several important papers that would, in the natural course of things, have been reserved for the yearly assembly having been read at these smaller, but more businesslike meetings. An addition to the number was made by the formation of an Association for the previously neglected district known by the name of the Eastern Counties; the first meeting being held at Grantham on March 20, under the presidency of Mr. Wm. Barratt. A suggestion was also made during the year for the formation of a similar Association for the North Wales district; and towards its close the idea took definite shape. The interest of all the regular meetings of the old-established Associations of this class was well sustained; and good work was done by the numerous foreign technical societies, whose transactions are regularly reported in the JOURNAL.

There has been a great deal to attract attention in what may be called the personal division of gas affairs. The miserable upset at Halifax, in which Mr. W. Carr was sacrificed to popular clamour, came under public notice continually during the year, as events developed. Little by little the party of the Mayor fell away and became discredited; and at last the only victim of the disturbance left to suffer from the disabilities then incurred was the unfortunate whilom Gas Manager, who in his exile at Johannesburg, South Africa, has had the poor satisfaction of a moral revenge. In the early part of the year Mr. Ellis Lever again raised the cry of fraud and corruption in regard to the coal supply of Salford, and repeated the performance at Leeds—making a disastrous *fiasco* in both cases. The old Salford scandal has dragged along throughout the year; receiving fresh life from the announcement in the autumn that the Corporation had compromised their claim for the return of all the illicit commissions paid to their late Gas Manager—Samuel Hunter—for a lump sum of £10,000. Acceptance of this amount was mixed up in a mysterious fashion with the getting up of a petition for mitigation of Hunter's punishment for perjury and fraud; and when the latter was rejected by the Home Secretary, the money was not forthcoming. In the middle of the public excitement caused by these events and rumours came the sensational announcement that an action for the recovery of commissions alleged to have been paid to Hunter had been instituted by the Salford Corporation against the Apostle of Commercial Purity—Mr. Ellis Lever—himself! Public opinion in the Manchester district was so disturbed by all these proceedings, that a movement was set on foot with a view to obtaining a Royal Commission to inquire into the whole subject, without which it is doubted that the tangled thread of intrigue and corruption will ever be unravelled. Meanwhile, it is hoped that the Act for the Prevention of Bribery, &c., in connection with the officials of public bodies, passed last session, will have a useful effect for the future. Among other personal matters may be mentioned the long and disorganizing dissensions among the Directors of the Bristol Gas Company; the visit of American Engineers to London *en route* to the Paris Exhibition; Mr. Corbet Woodall's professional tour in America; the deplorable illness of Mr. Robert Harris, of The Gaslight and Coke Company; and the final retirement of Mr. J. K. Watson, of Edinburgh, from active service.

Death has been unusually busy in the ranks of British Gas Engineers. Mr. R. P. Spice and Mr. G. W. Stevenson were representatives of the race of Parliamentary Consulting Engineers now nearly extinct. Mr. John Reid was identified with the rise and development of the gas industry of Scotland. Mr. A. H. Wood, of Hastings, was a popular member of The Gas Institute, and was one of the founders of the Southern District Association. Mr. S. P. Leather, of Burnley, was generally respected. Mr. Jas. Stelfox, of Belfast, had retired from active service; but he had done good work in his time. Mr. Lewis Thompson left a name that will be remembered among those of the foremost gas chemists of his day. Mr. D. Hulett was a man of considerable influence in his department of the gas industry. Mr. R. Bradshaw was a representative of the best type of modern gas director, as Alderman Sir Thomas Dakin was of that type of fighting directors who belong to a past age. No man was more widely known in his degree among gas managers generally, or better liked, than Mr. Donaldson, of Messrs. W. and B. Cowan. We have chronicled in the JOURNAL from time to time the deaths of many men of mark who had more or less connection with, and influence upon the development of the gas industry.

Of great disasters, accidents, and casualties arising out of gas supply in the United Kingdom there is happily none to record. Minor domestic explosions, fires, &c., traceable to ignorance and carelessness in the use of gas, have, of course, happened in various places; but there has been nothing to seriously trouble gas engineers, with the solitary exception of the deplorable fatality at the Saltley station of the Birmingham Corporation, where two men were lost in connection with the repair of a gasholder under air pressure. Although the story is redeemed by as much heroism as it has of sorrow, it is a pitiable incident. Often as the same kind of work is done, casualties are almost unheard of; but more care than ever will be shown in the future. The introduction of water gas in the works of the Leeds Forge Company was attended by the death of two men from carbonic oxide poisoning.

Finally, we will say one word for the JOURNAL. It is the constant study of the Editor and Publisher to improve with the passage of time in regard to the appearance, contents, and arrangement of these pages, and to continue to deserve for it in all respects the reputation which the JOURNAL has earned for many years, of being the first representative organ of the gas industry in this or any other country. As the discussion of technical subjects in connection with the industry is fostered by the multiplication of professional societies, and as competition among engineers leads to invention of new forms of apparatus and the introduction of new processes in manufacture, we find that the demands upon our space for chronicling and commenting upon such subjects encroach more and more upon the room formerly occupied by matter of mere local interest. We propose, therefore, with the New Year, to effect a few important, although not startling changes in type and arrangement, which we trust will be found to be improvements. Local and transient matter will be condensed and summarized as much as possible, which will allow for the use of clearer type throughout—

especially in the news columns; and, as always, every pains will be taken to make the JOURNAL, as an industrial and professional organ, in all respects full, fresh, clear, comprehensive, and reliable.

Water and Sanitary Affairs.

THE past year has not been productive of any remarkable events with regard either to the water supply or the drainage of towns. There has been an appearance of preparation, and there has been a change in the administrative machinery, due to the passing of the Local Government Act of 1888. The era of the County Councils has commenced, and the capability of these new bodies has yet to be tried. In London, the Metropolitan Board has been hastily swept away; the period for its demise being anticipated by eleven days, so as to give greater freedom of action to the new authority. On March 21 the London County Council passed out of the provisional stage and entered on the full exercise of its powers. In his inaugural address, Lord Rosebery, as Chairman of the Council, plainly indicated the ambition of that body with respect to the Metropolitan Water Supply. "The water "question," said his lordship, "has wrecked Governments, "and may wreck Governments again;" but he signified that the Council, so far from being alarmed at the prospect, were prepared to enter on the water question "with a light "heart." It was thus that the Council created a Special Committee "to consider the steps to be taken as to acquiring the "undertakings now supplying London with water." After making a great show of doing something, the designs of the Council took the comparatively modest form of a clause in their Money Bill, authorizing expenditure for the purpose of instituting an inquiry "with respect to the water "supply of the County of London." The Government had charge of the Bill, but found it necessary to drop the water clause; for which purpose the Bill itself was withdrawn, and re-introduced with the objectionable clause left out. In the coming session the effort is to be repeated by means of a clause in the General Powers Bill of the Council, whereby it is proposed that "it shall be lawful for the Council from time to time "to prosecute and conduct inquiries and negotiations relative "to the supply of water, or Companies supplying water, in or "near the administrative County of London, and to pay out "of the County Fund the costs and expenses of such inquiry, "not exceeding £5000." In addition to the clause in the Money Bill of the London County Council, sundry Bills relative to the Water Supply of the Metropolis were brought into Parliament last session by private members. Mr. O. V. Morgan made two attempts of this kind; and Mr. Firth made another. Mr. Firth's Bill only went so far as to propose inquiry; but Mr. Morgan's sought to confer power on the Council to purchase the rights of the existing Companies, the first Bill also including power to introduce new supplies. All came to naught; and it is quite possible that a similar result awaits such efforts in the coming session. But there is an evident disposition in Parliament to cripple the London Water Companies by legislative side-thrusts; while, at the same time, there is no great disposition to hand everything over to the County Council. The idea of a water supply by meter is sedulously cultivated by the Corporation of the City; but it is satisfactory to find that there is no hope of carrying a Bill for this purpose in the ensuing session. The meter case connected with the firm of Messrs. Cooke, Sons, and Co., of Friday Street, has been finally laid at rest by a judgment given in the House of Lords. Whether a warehouse in which nobody sleeps is a dwelling-house, is a question that remains where it was; but it is clear in the case of the New River Company that it is only where a domestic supply is already taken, that a legal demand can be made for a supply by meter for trade purposes. As a matter of fact, Messrs. Cooke, Sons, and Co. were endeavouring to get a domestic supply at "trade price;" and could they have succeeded, a very serious blow would have been struck at the London Water Companies, especially in those districts where warehouses and factories are abundant. We may note that the artesian well, resolved upon by the City Commissioners of Sewers, now nearly three years ago, and intended to scare the New River Company, still remains unproductive.

The fearful destruction consequent on the bursting of the Conemaugh reservoir in Pennsylvania, in the month of May, gave rise to some discussion as to the safety of large waterworks in this country. Naturally, attention was drawn to the great Vyrnwy reservoir, and the security of large artificial dams, restraining impounded waters, was made the subject of parliamentary interrogations addressed to the Government; but the replies showed that there was no real cause for apprehension. Sir Robert Rawlinson dealt with the topic in a letter to *The Times*, speaking of the Vyrnwy reservoir as "having a rock site and stone-wall embankment "which will be safe for all time." Replying to Mr. S. Leighton, in the House of Commons, Sir M. Hicks-Beach referred to the report of Sir Andrew Clarke, C.B., R.E., who stated that the wall forming the Vyrnwy embankment was so enormously strong that nothing short of an earthquake could possibly disturb it. The fears entertained by the inhabitants of Shrewsbury and other Salopian localities, that they might share the fate which befel the people of Johnstown, were thus proved to be groundless. The precise facts connected with the American catastrophe show that nothing of the kind is likely to occur in the United Kingdom.

With regard to extensions of the water supply in the provinces, mention has lately been made in these columns of the new and extensive works for which the Corporation of Bradford intend introducing a Bill in the coming session. Schemes for securing enlarged supplies are being brought forward also by the Corporations of Leicester, Plymouth, Huddersfield, Shrewsbury, and Derby, and by the Stockton and Middlesbrough Water Board. Concerning the progress of the water supply where it remains in the hands of the Urban Sanitary Authorities, the Local Government Board report that the loans to which they gave sanction for this purpose during 1888, amounted to £417,239—being the largest sum since 1880—the total for the decade being rather less than £2,600,000.

The Local Government Board returns show a much greater amount expended by local authorities for works of sewerage than for water supply. Loans to Urban Sanitary Authorities for sewerage and sewage disposal, as sanctioned by the Board, in the ten years ending with 1888, have somewhat exceeded £6,600,000; being more than double the amount for water supply. The same ratio occurs in the case of the Rural Authorities; water supply taking £500,000, and sewerage £1,096,000. During the same series of years, loans for sewerage works have been sanctioned in the case of Joint Boards, to the extent of £914,000. In addition to these amounts, borrowing powers of much greater extent, exercisable without the sanction of the Local Government Board, and for a variety of purposes, have been conferred upon local authorities by Parliament; the total sum involved being £46,000,000 in the course of seventeen years. Even this does not tell the entire story—general power being given in numerous cases to borrow unascertained amounts. The outstanding loans of the local authorities at the last date, presented the formidable total of £186,822,000. Of this amount, water works took £32,427,000; and works of sewerage and sewage disposal £18,389,000. In thirteen years the public rates levied in England and Wales have increased by more than 38 per cent. In London an outlay of 5½ millions has taken place in carrying out the main drainage plan, with the greater part of a million for the precipitation works at Barking and Crossness. After all, there is the prospect of a further outlay; the County Council showing a disposition to extend the outfalls so as to discharge the Metropolitan sewage direct into the sea, or else to carry out the old reclamation scheme, so as to fertilize the Maplin Sands. It seems certain that the ratepayers of London have not heard the last of the Metropolitan sewage. Mr. Webster's electrical method has not as yet received any marked attention from the Metropolitan authorities, although Sir H. Roscoe, at Mr. Webster's instance, has drawn up a report on the process, in which he speaks of it in terms of approval. Sir Henry states with regard to the process as exemplified at the Crossness works: "I have not observed, in any of "the unfiltered effluents from this process which I have "examined, any signs of putrefaction, but, on the contrary, a "tendency to oxidize." The cost of Mr. Webster's electrical method for the treatment of sewage may be considered as the real question at issue; and on this there is an official report forthcoming which will probably appear very soon. But the sewage question seems to be past all settlement, except that in certain cases there is a practical conclusion that "something must be done;" and very extraordinary things are sometimes attempted. Wimbledon has—at least, for the present—adopted the "Amines" process, in which an enormous quantity of lime is used. Kingston-on

Thames has become enamoured of our old acquaintance, the A.B.C. method. Every process has a strong party to condemn it, and an active party to support it. We may trust that, on the whole, the state of affairs with regard to town sewage is better than it was some years ago. In respect to the Thames, it is to be hoped that the long-standing abuse, whereby a portion of the town of Staines was allowed to pollute a water-course communicating with the main river, will soon be brought to an end. The promise of amendment was made to the Conservators some months ago, and notice has since been given of a Bill creating a Sewage Board for the district. But the financial proposals of the Bill will require some consideration on the part of the Water Companies who take a supply from the Thames; and we may expect that the Conservators will also have something to say on the subject.

Essays, Commentaries, and Reviews.

ELECTRIC LIGHTING IN 1889.

Another year's "Memoranda" upon subjects connected with electric lighting are now ended; and it becomes desirable to pause and think whether, and in what respects, our last notice of this matter for the current year can signalize an altered state of affairs as compared with their condition twelve months since. The year opened with a general movement in advance of electrical speculators who had been encouraged to make a fresh start by the amendment last year of the Electric Lighting Act in the direction of prolonging the period of Provisional Orders. London was the first to feel the effects of this revival, in the shape of a number of conflicting projects for lighting the Metropolitan area. These schemes were so irreconcilable by any method of separate investigation, such as would in the ordinary way be accorded to projects of the kind, that a special treatment was devised for dealing with them. Major Marindin, R.E., on behalf of the Board of Trade, held an inquiry at the Westminster Town Hall into the whole matter of the proposals to divide London into electric lighting districts. After a long investigation, Major Marindin reported that the idea of lighting London by electricity in the way indicated to him appeared feasible; and he accordingly recommended that the necessary Provisional Orders should issue under restrictions reported at the time. Thus sanctioned, the different Metropolitan electric light undertakings have been busy throughout the whole year in establishing their works and making preparations for the underground distribution which is understood to be a *sine quâ non* of their future success. The variety among these ventures is sufficient to ensure a trial of every acceptable method of electric lighting within the Metropolitan area. It is reported that upwards of half-a-million sterling has been laid out during the year by the London Electric Supply Corporation, who contemplate supplying a very large district of Central and Western London by high-tension alternating currents generated by the enormous plant at Deptford, and transformed into low-potential currents at the entry upon the consumer's premises, after the Gaulard and Gibbs model. Another large venture is that of the Metropolitan Electric Supply Company, who also propose to do business in Central and Western London, but have adopted the plan of direct supply by continuous currents from stations situated in the districts to be served. Distribution by the aid of secondary batteries is the system adopted by a large Company with head-quarters in Chelsea; and there are several small undertakings established in Kensington and other favourite West-end districts. So far, however, not much business is being done by any of these Companies. The great Deptford station was to have begun working in October; but it is still dark. Meanwhile, the public are growing seriously alarmed with respect to the danger of electric light currents, especially of the intensity contemplated by the London Supply Corporation. Several horrible casualties, caused by lighting wires having occurred in New York, where the electricians from being favoured by the public have ended in being generally condemned, it is probable that before any English electric light undertaking is permitted by the Board of Trade to send out a dangerous current, it will be required to furnish very complete guarantees for the public safety.

The preliminary success of the Metropolitan electric lighting ventures in obtaining the sanction of the Board of Trade inspired a number of electric supply companies, such as Messrs. Crompton and Co., Limited, the House-to-House Electric Light Company, and others, with the idea of repeating the tactics of their forerunners of 1882, now mostly defunct, and sending out broadcast notices of their intention to apply for Provisional Orders for invading all the cities and towns of the United Kingdom. These notices have in many cases had the desired effect of frightening local authorities into themselves applying for Orders, with a view to keeping out unwelcome strangers. Consequently, the Board of Trade records for the year will show an extraordinary expansion in the demand for Electric Lighting Orders; but the genesis of this sudden movement, as we have given it, does not justify the conclusion that might otherwise be drawn from the surface indication as to the remarkable disposition of British local authorities to embark upon electric lighting. The year's history of the electric lighting movement as displayed in this country might therefore be summarized as active preparation for making the commercial test of the idea in London, and legislative preparation throughout the provinces on the part of local authorities desirous of preserving their highways from intrusion by electric light speculators.

Abroad matters seem to remain much as they were a year ago. The electric lighting of the Paris Exhibition was not so different from that of the recent South Kensington Exhibitions as to constitute a new departure in *technique;* and experience shows that there is no necessary connection between costly public displays of this character and commercial progress. Large electric lighting plants have been established in Berlin, Milan, Vienna, Rome, and other places on the Continent—the two last-named undertakings being the property of gas companies. In America the union of electric light ventures with gas supply has progressed, chiefly in the Western States, where few concerns of the kind are of any great magnitude. The same thing would be done in the Eastern States and the larger cities if the electricians could have their way; but so far electricity displays much more affection for gas than is generally reciprocated. Very few electric light companies in America are believed to pay on their own merits, though the work is done in a cheap, rough-and-ready style that would not be tolerated elsewhere. American experience shows that even when its rival is gas selling at double and treble British rates, the limit of the demand for electric light in a community is soon reached, beyond which there is no expansion of the trade. Within the first year or two of getting to work, an electrical supply company secures all the custom it has to hope for; and the profit from wiring premises also comes into this period of its existence, giving the proprietors illusory hopes for the future. After this hey-day of growth and promise, however, things begin to go queer. No new consumers are to be found, and some of the early ones grow tired of paying the high charges for a light that has its own faults. Meanwhile the plant—especially the insulated mains—is getting worn out, and needs renewing. Then the proprietors look out for a gas company to amalgamate with on easy terms. Such is the history of many an electric lighting venture in the United States and Canada.

The technical condition of electric lighting plant is little different from that observed at this time last year. Dynamos have been cheapened and rendered more efficient per unit of weight; and the Edison and Swan Company have strengthened their grip upon the trade in incandescent lamps, which have been cheapened by 25 per cent. Mr. T. A. Edison has visited England and Paris; but, beyond a number of smart sayings attributed to him, has not left anything novel behind him. The experiments in street lighting with incandescent lamps at Barnet and Leamington have demonstrated once more that this system of lighting is useless for the purpose; and although the Commissioners of Sewers of the City of London have made a new contract with the Brush Company for street lighting, it is at a price exceeding that received by the Company for the same service seven years ago. If price is a test of progress, therefore, it does not appear that arc lighting has improved much of late years. A generally acceptable electricity-meter is still to seek; all the instruments of this order at present known being expensive, and the majority unreliable. The expected development of electrical engineering in the direction of locomotion and for power purposes generally is progressing very slowly, if at all, in this country. The Institution of Electrical Engineers was founded during the year, on the basis of the old Society of Telegraph Engineers and Electricians. An International Congress of Electricians for the settlement of standards of electrical measurement and other purposes was held in Paris during the continuance of the Exhibition; but nothing worthy of record came of it. On the whole, it must be allowed that the year has seen much effort on the part of electricians, who are working hard to overcome the difficulties of their interesting industry.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1264.)

The past week has naturally been a very unimportant one in the Stock Exchange—with two holidays coming right in the middle of it. The extent of business transacted has been much restricted; but, notwithstanding this, there was no show of weakness for lack of support. On the contrary, general firmness was the prevailing characteristic; the only exceptions being special cases (such as Brazilians) obeying special influences. The Gas Market may also be written as firm, in spite of a slight falling off in Gaslight "A" and South Metropolitan "B." This slight fall, we have no hesitation in declaring, was the result of the extremely alarmist tone struck by a leading newspaper in its daily commentaries upon the gas industry of London. The very fact that the stocks of the two chief Metropolitan Gas Companies have been so slightly moved by what was almost calculated to produce a panic in some minds, is a proof of their intrinsic strength. For our own part, we believe that a general strike of the gas stokers of London is highly improbable: First, because there are no funds to support them if they are all out of work at the same time; and, secondly, because it would not in the least add to the difficulties of the South Metropolitan Company, which is put forward as the object to be attained. The actual fall in quotations was 8 in Gaslight "A," and 1 in South Metropolitan "B." Gaslight secured issues are rather better, with a rise of 1½ in the 4½ per cent. debenture stock. Commercial new also improved 1. Variations in Suburban and Provincial undertakings are represented by an advance of ½ in Alliance and Dublin. Among the Foreign division, a similar advance has been made by Bahia and Buenos Ayres;

but Pará has receded to an equal extent. The Water Companies have been quite neglected, and present nothing to note.

The daily operations were: Gas opened rather weaker on Monday for Gaslight "A;" and a fall of 1 was marked. Commercial new, however, advanced 1, and Alliance and Dublin and Buenos Ayres, ¼ each. On Tuesday, Gaslight "A" lost 1 more; being done at 248¼. What few other issues were dealt in, showed fair prices. Wednesday and Thursday were holidays. Friday was very quiet. Gaslight "A" marked 247—the lowest of the week. Both it and South Metropolitan "B" receded 1. Saturday brought no further change; and the only transactions marked were in Gaslight "A," at 248, and South Metropolitan "B," at 238—nearly top price.

THE DESIGN OF GASHOLDER HOUSES.

At the recent meeting of the German Gas and Water Works Managers' Society, which was held in Stettin, Herr Reissner, of Berlin, read a paper upon the new municipal gas manufacturing station in Berlin, in connection with which he described the construction of a gasholder house. We shall probably translate this paper in due course, but for the present we propose to discuss a general question that arises in regard to the design of Continental, as compared with English gas manufacturing stations. In passing through any part of the United Kingdom by railway, one of the most conspicuous objects in or near all towns of any size is the gas-works, with its two or more gasholders sombre with tar or glaring with red and white oxide paint, according to the taste of the manager. On the Continent, with the exception of a few regions where the climate is equable and temperate, there is no such an object as a gasholder to be seen in the landscape. It is consequently by no means easy to find the site of the gas-works, in default of the usual landmark. Now, although gasholders are necessary in the production of gas, and are objects of envy to the aspiring electrician, who has nothing at all corresponding to them in his list of lighting apparatus, they cannot be truly described as ornamental constructions, or as contributing in any degree to the beauty of a landscape. There is something hopeless about their form, to say nothing of their colouring, to the eye of an artist; and it is certain that if a landscape painter wished to represent a town in its most picturerque aspect, he would never select the point of view which embraced its gasholders. Whether obtrusively full of their store for the night's consumption, or shrunken below their geometrically disposed guide columns, gasholders have nothing picturesque about them. There have been many attempts to correct this defect by engineers who had a praiseworthy reluctance to disfigure the neighbourhood of their works by an ugly structure if they could possibly avoid doing so; but the result of such labours has been *nil*. A great deal of money has been wasted in this way from first to last; but from the ornate columns and spandrils of Mr. Kirkham's monumental holder at Fulham, to the poor little finial stuck on the end of the spindling columns of a village gasholder, all are deplorable failures. It is impossible to cure an unornamental form of its ugliness by putting ornament upon it. In the case of a gasholder, cast enrichments and careful painting in contrasted tints are only visible close at hand, where, as a rule, they are not noticed. They leave the distant view of the holder, which is that taken by the vast majority of people, precisely what it would be if it had no ornament at all. For this, among other reasons, we have recommended designers of gasholders to eschew ornament, and fall back upon fitness. If they are condemned to put their constructive genius into structures which in general estimation disfigure rather than adorn the landscape, they can at least preserve the virtue of consistency. Candid utility is not without its own redemption; and ugliness may excuse itself provided it does not ape the beautiful. These remarks apply wholly to the circumstances of ordinary English practice, where the holder stands out nakedly before the world. Where the holder is enclosed in a house of brick or stone, the case is altered; and there is no reason why it should not add to, instead of detracting from, the beauty of any town.

The earliest of our English holders were enclosed in strongly-built houses for prudential reasons. For artistic reasons it may be urged that it is a pity they were ever allowed to dispense with housings. Where the climate oscillates between extreme heat and cold, the house is indispensable; and whatever may be said against housing on the score of expense, it undeniably improves the appearance of the works and removes an eyesore from many a town. We would not be misunderstood in regard to this matter. It would be absurd to argue on behalf of gasholder houses for localities where they are not really required. On the other hand, it may be wise sometimes to show so much regard for the scenery of some particular spot where for special reasons a gasholder is required, as to put it in a well-proportioned house. What we have in view at the present moment, however, is the necessities of those gas managers who are obliged to protect their gasholders by brick or stone houses; and to them we say that this requirement affords them an opportunity for avoiding what is in the eyes of many people one of the greatest causes of offence in connection with gas supply. If a gasholder must always be ugly, a gasholder house may easily be made ornamental. It is purely a matter of educated taste. There are two schools of design to be recognized in this class of structures, the American and the Continental. Americans come to Europe in search of the picturesque; but they lie under the reproach of ruining their own country by the brutality of their commercial and industrial buildings. If one wishes to see how hideous a gasholder house may be made, there are plenty of examples to this effect in the United States and Canada. If on the other hand, he wishes to learn how to build such structures with due regard to their sightliness, let him go to Germany and Austria.

As to the comparative expense of ugly and handsome gasholder houses, which is sure to be mentioned by constructors of the so-called cheap school, it will probably be found on examination that there is little to choose. Beauty in building is not always a question of outlay; it is more commonly attained by the exercise of common sense and good taste. Many men who glory in calling themselves engineers, and think it a brave thing to despise architects, waste a lot of money upon an ill-proportioned building, and then bedizen it with ornament in a way to drive a tasteful man frantic. There are not many engineering works that can be made architecturally graceful; but when the opportunity is provided, as in the case of gasholder houses, the man who neglects it is a Philistine. What then is the difference between the ugly and the artistic gasholder house? Very little, in one sense; everything in another. A plain ring of brickwork, pierced with ventilating holes, and surmounted by a conical iron roof, may be taken to represent the one. The other, as in the Berlin example, will also be of brick; but its plainness will be relieved by string courses and mouldings, and the cornice will be a bold finish to the vertical line. Then a domed roof is not only more elegant, but is also more in correspondence with the form of the moveable structure which it covers. Result—in the one instance an eyesore; in the other a building on which the eye rests, from a near or distant view, with pleasure. Is not this worth something?

This consideration arises out of the same fundamental principle which underlies Rivers Pollution and Smoke Prevention legislation—the growing conviction that no man ought to seek his own profit or convenience to the loss or annoyance of his neighbour. If the choice of the community lay between a factory which emitted no smoke nor foul odours, poisoned no stream, and was not a blot upon the landscape, and another which was entirely the reverse, which would be preferred? So in all matters relating to gas supply, we hold and teach that nothing short of the best possible gratification to the community should satisfy the conscientious manager. If there are means for the prevention of noise, steam-clouds, smoke, evil odour, or any other concomitant of gas-making to which the community can reasonably object, then those means should be adopted. And—this is for foreign and continental consumption—if a gas company, having to build a gasholder house, deliberately chose the cheap and ugly in preference to the neat and elegant style of design, and thus outraged the susceptibilities of the locality, they would have themselves to thank if public opinion went against the renewal of their concession. The remark that applies to the designing of gasholder houses also applies to other matters of commoner occurrence. Wanton lapses into ugliness, when neatness and even elegance is equally attainable, is a sign of ignorance; and ignorance means waste. The man who builds a clumsy house is apt to put twice the weight of metal into a girder that it really requires for the work to be done; and, if criticized on the point, thinks to save his reputation by claiming his determination of making a "strong job." Ability to make a "strong job" is not, however, the sole test of an engineer. It is one point, of course; but as in testifying before a Court of Justice, a man must not only tell "the truth, the whole truth, and nothing but the truth," so in engineering there should be the strength, the whole strength, and nothing but the strength required.

The consideration of this subject has gone a little beyond the point in which it originated; but the argument will not be wasted if it shows that regard for fitness first, and then for so much elegance as may be attainable, is to be expected of an intelligent gas-works constructor, whether he has to build a gasholder house or any other permanent structure.

In consequence of the large amount of work which has lately been thrown upon the Railway and Electric Lighting Departments of the Board of Trade, it has been necessary to provide additional office accommodation. This has been secured at No. 8, Richmond Terrace, Whitehall, where the business of the two above-named Departments of the Board will shortly be carried on.

In the report of the proceedings at the inquest on the two men who lost their lives at the Saltley Gas-Works of the Birmingham Corporation, as given in the Journal last week, Mr. H. Hack, the Engineer of the station, was made to say that to have emptied the tank of the holder in which the accident occurred would have been dangerous, unless other tanks had been emptied too. What Mr. Hack really stated was that "the water in the adjoining tanks would have had to be lowered, so as to reduce the head and lessen the risk."

We have to record the death, on the 23rd inst., at Cannes, from paralysis, of Sir Joseph Heron, the Town Clerk of Manchester Sir Joseph was born in 1809, and was the first occupant of the position he filled up to the time of his death; the appointment having been conferred upon him in 1848. He was intended for the profession of the law; and although he abandoned it in order to throw himself into the municipal questions which were agitating his native city, the legal knowledge he acquired proved of immense value in the position he was called to fill. At the time of his appointment the gas supply was already in the hands of the Corporation. But the great scheme for supplying the city with water from Lake Thirlmere had to be initiated and carried out; and this undertaking will always figure conspicuously in connection with the legal campaigns in which Sir Joseph won renown.

Communicated Articles.

FORMULÆ FOR GASHOLDER STRAINS.

By V. Wyatt.

In a recent number of the Journal (see *ante*, p. 872) there is an exhaustive review of Mr. Cripps's interesting treatise on "Guide-Framing to Gasholders," in which it is implied that gasholders, until quite recent years, were designed upon the rule-of-thumb system, and by mere guess work, and that formulæ for the due and safe proportions of their several parts were not only not in use, but even not known. This statement shows that the writer knows but little of the evolution of gasholder construction. Engineers in years past, as a rule, trusted quite as much to reliable calculations and formulæ to arrive at safe structural results as they do at the present time; for the simple reason that then works of precedent, both theoretical and actual, were more scarce than now. There was not such a large field of trials, failures, and accomplished facts to draw from as are now embodied in what we call engineering experience. The modern engineer has been specialized and diplomatized; he elaborates graphic strains, but unfortunately he dispenses too much with personal observation, external experience, and the language which speaks out palpably, to those who listen, from the actual works themselves.

I reproduce below a series of formulæ from my note-books, as applied to gasholder and purifier construction, by others as well as myself, since 1868. Previously to that date, even these formulæ, modified to suit the special circumstances, were used in the designs for cylindrical vessels with domed ends, more or less flattened, to resist internal pressure from water, steam, compressed air, &c., as well as for domed and arched structures of very solid materials. Such structures could not have been carried out and safely proportioned in their several parts, either in ancient or modern times, by mere empiricism and instinct, and without intellectual labour, rule, and formula.

All the formulæ are based upon very ancient geometrical rules and equations; and have the simple merit of ready facility in their application. They denote the strains given out by internal pressure on the crown and side of the gasholder, when the crown is untrussed. These strains can, however, be considerably modified and reduced by the introduction of suitable framing to the crown of the holder, and to which the sheeting plates are riveted. There is not the slightest objection to the latter practice, provided the sheeting of the holder be first inflated to half pressure, before securing the same to the framing members. Two or three open joints can be left to each rib of the trussing, at those points where the cover plates occur in the flanges, until the stretch of plating is determined, when the framing can be adapted to the strained rise of the crown sheeting; and then all can be riveted up together *in situ*. The crown trussing can be adopted economically to relieve the heavy strains shown in the formulæ—upon the crown and curb of a large holder to the extent of at least 50 per cent., and this with an expenditure of iron of only about 7½ per cent. of the floating weight of the holder. To do the same duty by the top curb, there would be required an amount of iron equal to from 15 to 20 per cent. of the floating weight. This arises from the fact that one ton of iron in the trussing does the duty of two tons of iron in the crown sheeting and curb, as the rivets are twice as widely spaced in the former class of work, and the trusses can be made twice, or even more, the depth of the crown; the latter being attained in the interior of the vessel, and without in any way affecting the crown shape. The iron scantlings for the crown ribs are only injured by punching to the extent of about 25 per cent. as compared with gasholder joint work, which is shockingly cut up to the extent of from 60 to 66 per cent. of the solid plate, and only secured by cold riveting and tape joints.

Gasholders can be trussed in the crown as effectually and economically when designed on a large as on a small scale. Say, for example, you have a gasholder of 100 feet diameter, with the crown trussed to a given model. Then repeat this system over the area of the crown as many times as the area of the larger structure exceeds that of the smaller one; taking care to have one support, in the shape of a small brick pier rising from the tank cone, for each unit area of 100 feet diameter. Then there would be trussing for the crown, doing duty to the full extent of its scantlings by reducing the curb section, with a less strain upon the joints of the crown plates, a capacity to support the holder crown when at rest on the bearing stones, and also at any height, temporarily, for repairs in the event of a "jam" or "hold up" in the run, and a total dispensation of the wood framing and forest of fir poles now used in tanks to support the untrussed or bladder system of gasholder crowns. The wood and iron framing used in some of these tanks has cost from 15 to 20 per cent. of the iron value in the floating weight of the holder—sufficient to pay twice over for the material used for properly trussing the crown, to say nothing of the curb economy above stated.

Wyatt's curb is alluded to on p. 96 of Mr. Cripps' treatise; but it is misrepresented. The compressive strain does not come upon the point marked with a × on the upper part of the diagram in the book, and thus bring into action only a portion of the sectional area of the curb. The curb section (fig. 1) is a quadrant of a cylindrical column, struck from a 3-foot radius; with the double advantage of being curved or corrugated, horizontally and vertically, against the strain, and is stiffened at intervals by longitudinal

Fig. 1

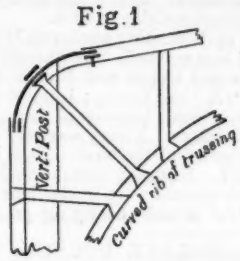
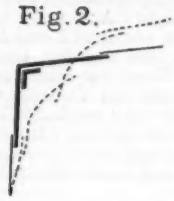


Fig. 2.



and transverse cover strips to joints. Besides, it is stayed internally, against buckling, by bracket pieces, and the rounding in of the crown ribs and vertical posts to the shape of the curb. Every square inch of the curb sectional area is equally efficient as part of a horizontal tube to take the *compressive* strain. The ordinary form of curb made of two flat plates, placed nearly at right angles to each other, and connected by an internal L-iron (as in fig. 2), being neither corrugated nor formed to a shape fitted to resist a high compressive duty, is truly adapted to promote buckling and weakness. The rounded curb will take a *safe* strain of four tons per square inch of section; whereas it is extremely doubtful if the other curb should be trusted to one of more than two tons.

The curb, fig. 2, assumes the shape of the dotted lines on the diagram when tested under a compression of from one-half to two-thirds the crushing weight of fig. 1; and it then tries to approximate in form to the true cross section of the latter. Fig. 1 may be described as a curb which requires *crushing*, whereas fig. 2 only requires *buckling* to destroy the structure. The rounded curb was suggested to me by observing that all *square* corners in structures buckle and rip more readily when under extreme testing strains, and at about one-half to two-thirds of the force of that would similarly affect structures with *rounded* corners. Hence all boiler-makers and shipbuilders try to round off the angles of their work to the utmost possible extent, so as to prevent an early malformation of material, setting up abnormal strains in the work.

I am pleased to see Mr. Cripps appreciates and uses in his formulæ a wind force of 52 lbs. per square foot of *plane* surface, by allowing one-half of this (26 lbs.) as being effective on the *round* form of the holder. We may expect any and every year a gale of wind reaching a pressure upon the plane surface of half a cwt. to the superficial foot. This has been very nearly reached again and again in the neighbourhood of London. Mr. Baker, of the Forth Bridge, asserted for years that about 20 lbs. per superficial foot was the maximum force which Nature put forth in this shape; and that all wind-measuring instruments told fibs. He appears now to be converted to the 56-lb. scale; and he finds that by far the greater force with which he has to contend in bridge design is that resulting from wind. It is upon this item that by far the largest portion of the steel has been expended in the construction of the Forth Bridge. The recent observations at the Eiffel Tower in Paris show that for each 100 feet in height of structure there is an increased velocity and pressure of wind of 33 per cent.

We must all thank Mr. Cripps for the carefully worked-out details in his treatise. There is one point, however, which I think requires explanation. Note E, on page 25, I have read two or three times over; and have not yet seen its lucidity. He is writing as to the way in which the wind operates upon the external framing of the holder through the medium of the holder itself. He says that "with regard to gas pressure pushing the holder forwards against the columns on the opposite side to the wind, and *dragging* (as it were) the other half of the holder after it." To illustrate this, there is a diagram showing a sliding box within another box; the latter having an open end, through which the former slides, with a water-tight joint. They are supposed in the illustration to be both filled with water to justify the conclusion drawn in this case. Now, supposing there be *no water* put into the sliding box, and yet there be water poured into the fixed box and behind the sliding box, then the latter will still move out of the fixed box just as it did when both boxes were filled with water. The water in the sliding box (like the gas in the holder) cannot therefore move it forwards, for there is none in this instance to operate; and the sliding box, in its entirety, framework and all, must therefore be moved by the water in the fixed box. Consequently, it is not the gas *inside* the holder which drags it forward on to the framing for it has nothing to do in the case; but actually the wind itself, which operates externally on the windward side of the holder. Q.E.D. This looks to me like an idea "o'erleaping itself and falling on t'other side."

I will now give the formulæ above referred to. The notation used is defined in detail below. The example taken to show the working out of the formulæ in figures is that of a large holder, with a storeage capacity of about three million cubic feet of gas; diameter 200 feet, rise of crown 10 feet. The floating weight of holder, when telescoped, is assumed to be 557 tons, and the gas pressure 7½ inches—equal to about 40 lbs. per superficial foot of sheeting surface.

T = Tangential *tension* strain in tons from *one-fourth* of the crown area, which is the portion acting on *one* sectional area of crown curb. This portion of the area is preferably selected in the formulæ on this account.

T^1 = Tangential *tension* strain in tons on *one foot* in length of the crown sheeting, taken in any direction; and also on one foot of the crown curb.

C = Horizontal and *compression* strain in tons on the crown curb, and on any one section of the same, taken at any point, clear of all cover plates.

P = Vertical *effective* pressure in tons on *one-fourth* of the crown area (being the gas pressure, 7½ inches, say 40 lbs. per superficial foot, less the weight of the crown—say, for convenience of calculation, 10 lbs. = 30 lbs. net per superficial foot), = 104½ tons in example.

$$\frac{200 \times 200 \times 0{\cdot}78 \times 30}{4} \div 2240 = 104\tfrac{1}{2} \text{ tons.}$$

P^1 = Pressure of gas per superficial foot of crown and side = 40 lbs. = about 7½ inches water.

P'' = *Effective* pressure of gas in pounds per superficial foot of crown = 30.

D = Diameter of holder in feet = 200 in example.

R = Radius of crown in feet = 505 ,,

R′ = Radius of side of holder in feet = 100 ,,

S = Tension strain on one foot vertical of side plates, in tons.

V = Versed sine or rise of crown in feet = 10 in example.

1. $T = \frac{P\,D}{4\,V} + \frac{P\,V}{D} = \frac{104{\cdot}5 \times 200}{40} + \frac{104{\cdot}5 \times 10}{200} = 528$ tons.

2. $T = \frac{R\,P}{\frac{D}{2}} = \frac{505 \times 104{\cdot}5}{100} = 528$ tons.

3. $T' = \frac{\left(\frac{D^2}{2} + V^2\right) P''}{4\,V} = \frac{10100 \times 30}{40} = \frac{\text{lbs.}}{7575} \div 2240 = 3{\cdot}4$ tons.

The last formula is used by Mr. Cripps with his own notation.

4. $T' = \frac{R\,\frac{P''}{2}}{2240} = \frac{505 \times 15}{2240} = 3{\cdot}4$ tons.

5. $T' = \frac{T}{\frac{1}{4} \text{ circ. of holder}} = \frac{528}{157} = 3{\cdot}4$ tons.

6. $C = \left(\frac{P\,D}{4\,V} - \frac{P\,V}{D}\right) 0{\cdot}64 = \left(\frac{104{\cdot}5 \times 200}{40} - \frac{104{\cdot}5 \times 10}{200}\right) \times 0{\cdot}64 = 331$ tons.

7. $C = \left(T - \frac{P\,2V}{D}\right) 0{\cdot}64 = \left(528 - \frac{104{\cdot}5 \times 20}{200}\right) \times 0{\cdot}64 = 331$ tons.

8. $C = \frac{\left(\frac{D^2}{2} - V^2\right) P''\,D}{8\,V} \div 2240 = \frac{(10{,}000 - 100) \times 30 \times 200}{80} \div 2240 = 331$ tons.

The last formula is also similar to that used by Mr. Cripps for the compressive strain on the crown curb; but it is not encumbered with the + and − quantities added on to his equation, representing the internal pressure of the gas and the external pressure of the wind on one-half of the side of the upper lift of the holder. These pressures balance each other or become inappreciable, with ordinary gasholders, as the gas pressure usually varies from 5 to 6 inches of water = 26 to 31 lbs. per superficial foot, which corresponds nearly to the maximum *effective* force of wind gales, $\frac{56}{2} = 28$ lbs. per superficial foot of exposed surface. For special holders giving 9 inches and 12 inches of gas pressure as now used in extreme cases and for chemical works, and also for water and steam vessels under pressures, reductions should be made from the formula C equal to the diameter of holder × by one-fourth the depth of the upper lift, × by difference between the external and internal pressures, and the result divided by 2 for the two sides of the top curb. Even a difference of 6 inches between the pressures on the inside and outside of a holder 200 feet diameter would only relieve the curb strain (C) about 5 per cent. It may be remarked that it is hardly safe to make holders to work at much less than 6 inches gas pressure, otherwise the external wind force from an extreme gale would be liable to buckle the sides, unless special provision be made in the construction to meet this event.

9. $S = \frac{\frac{D}{2} P'}{2240} = \frac{100 \times 40}{2240} = 1{\cdot}8$ tons.

10. $R = \frac{D^2}{8\,V} + \frac{V}{2} = \frac{200 \times 200}{80} + \frac{10}{2} = 505$ feet.

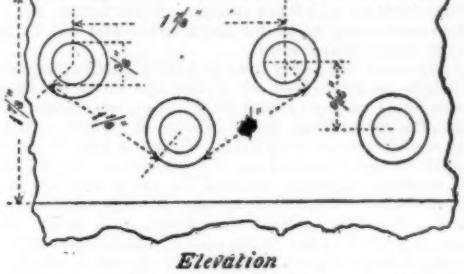
11. $R = \frac{\frac{D^2}{2} \times V^2}{2\,V} = \frac{10{,}000 + 100}{20} = 505$ feet.

From the following table showing the application of the above formulæ to a gasholder 200 feet diameter but with varied rises (V) to the crown, it will be seen that the tension and compression strains on the crown plates and top curb are approximately, but inversely, to the rise of crown (V) for a small rise, up to about one-tenth of diameter. When the semi-dome is reached, C becomes *nil*, and T equals only the vertical effective pressure on the area of the quarter dome; and the tension then on the crown plates would be only one-half of that on the side plates (S), assuming the same *effective* pressure in both cases. Here however it would be 25 per cent. less than one-half, as the weight of the crown plates has to be deducted = 10 lbs. per superficial foot. The table also teaches that by making the rise (V) one-tenth of the diameter (20 feet), instead of one-twentieth (10 feet), as in the example, the strain on the top sheeting is reduced nearly one-half, or 1·8 tons in tension (T^1) per lineal foot, all ways in the former, as against 3·4 tons in the latter case. The strains on the sheeting plates for both the crown and sides of the holder are now the same, 1·8 tons per lineal foot. The compression strain on the curb (C) is also reduced about one-half, as 161 : 131. This is obtained by an increased area and weight of crown plating of only about 3 per cent., with an extra value of gas in stock, at a prime cost, or capital expenditure of about £20 only. A convenient and safe radius for gasholder crowns is from 150 to 250 feet, giving strains of 1 ton and 1¼ tons per lineal foot of crown plate, and according to size of holder, for ⅜ inch plates.

Diameter of holder D ft.	Rise of crown of holder V ft.	Surface of dome = 6·2832 R V Sup. ft.	Ratios of dome to plane surface area.	Radius of dome = R feet.	Tension on ¼ of dome = T Tons.	Tension on one foot in length of dome = T^1 Tons.	Compression on one section of top curb = C Tons.
200	0	31,416	1·0000	0			
,,	10	31,730	1·0100	505	528	3·40	331
,,	15	32,091	1·0214	340	348	2·20	213
,,	20	32,672	1·0400	260	272	1·80	161
,,	25	33,300	1·0600	212	222	1·40	126
,,	40	36,442	1·1600	145	151	0·96	70
,,	50	39,250	1·2500	125	131	0·83	51
,,	100	62,832	2·0000	100	104½	0·67	00

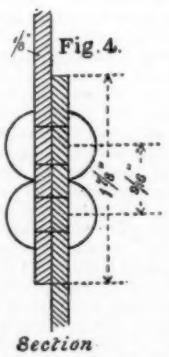
The present system of riveting up the sheeting plates to gasholders, with tape joints and cold rivets, is very defective. Not more than 33 per cent. of the strength of the solid unpunched plate is obtained by the ordinary riveted joints; and the very finest of this class of work only reaches to 40 per cent. This system should be rectified for large holders by increasing the laps to the plates of the crown about 50 per cent., and using a double line of rivets to the joints, about 20 per cent. larger in diameter than

Fig 3.



Elevation

Fig. 4.



Section

those now used (⅞ inch for ½ inch plates), put in *hot*, without tape, and a thick coat of red-lead paint in the joint. The strength of the joint would then be increased fully twice that now in use, and probably, if carefully performed, reach to 70 per cent. of the solid plate. This method of riveting is much better than increasing the thickness of the plates; as it is preferable to pay for good workmanship than for extra weight of iron. At present some of the large holders in use cannot be said to have the safe factor of four, as usually recognized for iron structures. The method here proposed for double zigzag riveting for use in the crowns of gasholders, and even for the sides, is shown by figs. 3 and 4, where, assuming the sheeting plates to be ⅜ inch thick, the laps are 1⅞ inches, the rivets ⅞ inch diameter, centre to centre of rivet diagonally 1⅛ inch, centre to centre of rivet longitudinally 1⅞ inch, and distance between centres of rows of rivets ⅞ inch.

The London Agents of the Johannesburg Water-Works, Estate, and Exploration Company, Limited, have addressed a letter to a financial contemporary pointing out that the Company's sources of water supply have been already increased by the purchase of additional rights to meet the increasing demand; that these sources have never been known to fail; and that the distribution is chiefly by gravitation, and therefore economical. Mr. G. R. Andrews, late of Brighton, the Company's Engineer, reached Johannesburg on the 2nd ult., and on the 20th cabled his perfect satisfaction with the Company, which he regards as a good paying concern.

WATER BY MEASURE.

By "High Pressure."

The above subject has been much discussed lately in your columns; but perhaps a few words more, by way of completing what has already been advanced, may not be uninteresting to your readers. Although there may be in this contribution some remarks of the same import as those already brought forward by "Meter,"* yet to make the argument clear it may be necessary to go over the same ground to a limited extent.

This is an age of invention, and new water-meters are being introduced in rapid succession. Which form will be adopted when the County Councils have obliterated all the old systems, and substituted fair and equitable (?) laws, remains to be seen; but I think the advocates of low-pressure meters must be more active than hitherto if they mean their system even to have a trial. The low-pressure meter was among the first in the market, and certainly could not have had a more able exponent than Mr. T. Hawksley to recommend it to the water-works world; yet after communicating with upwards of a hundred works, I find only twelve companies partially using this class of meters. Of course, there will be discussion in the County Council, and also by Parliament, as to the best means of supplying cities and towns with water; and no doubt the same amount of intelligence (?) will be displayed as on the last occasion of this subject occupying the Legislature—viz., when the Grand Junction Water Bill was discussed by that assembly of unpractical men. Before such a tribunal, there will be no difficulty whatever in passing a Bill enacting that all companies alike shall supply water by measure at 6d. per 1000 gallons, the consumers to find their own meters, or, if otherwise, at a rental of 1s. per quarter—the repairs to be left to their own discretion. But the Bill will, as usual, not apply to Scotland or Ireland; for what is supposed to be useful for England is not applicable to those countries. The low-pressure meter was invented about 1820; and if its merits are so high, why is it that less than twenty towns have used only a very few, and the high-pressure meter has been universally adopted? No one has disputed that a low-pressure meter can be made to register correctly; but the faults already enumerated from time to time in the Journal will be sufficient to condemn it for practical purposes—in fact, the requirements of the consumer are in advance of low-pressure meters. I will take the Odessa Water Company as an example. They supply their customers by meter; do not pay dividends; and the last balance-sheet shows an increase on the meter account of £500. The total number of meters fixed is 5000, which are valued at £19,000, allowing for depreciation; and I suppose calling the life of the meter ten years. The maintenance of these meters and general working expenses in connection with them amounts to £1100 per annum. Such figures do not need any comment; they speak for themselves—and not in favour of changing our present system.

Let us take an imaginary town of 40,000 inhabitants, and suppose Parliament to enact that all consumers shall be supplied by measure; this may represent 5000 houses or meters. The cost of these, including fixing, would amount to £20,000 (some positive meters would be even £30,000). Whatever may be the cost, the rent of these meters should pay the interest on the capital. The extra working expenses incurred for meter readers, inspectors, office clerks, repairs, adjustments, testing, depreciation, and renewals, including carriage and fixing, will exceed £1200 per annum, as proved by the actual cost of maintenance and working expenses of 5000 meters at Odessa. To change a rateable system into a supply by meter, this sum would be exceeded. What company can be quoted capable of maintaining such an outlay and continued working expenses? The American water-works reports state that from 10 to 12 per cent. is a fair average for cost of maintenance and depreciation of the meters. The cost of inspection in a town of 40,000 inhabitants, as now carried on without meters, with all expenses attendant on checking waste and keeping the consumption below 20 gallons per head per day, will not exceed £200. Here is sufficient margin to allow for extensive new works and also much waste of water. The cost of constructing new water-works with the meter system would be practically 50 per cent. in excess of the cost without meters; and this must be borne by the consumers. If a dual supply, as has been advocated, should be foisted on the people, and two kinds of water were distributed to every house, the capital will be still more largely increased. No private company will advocate the use of meters for a domestic supply with the object of gain, but it is sometimes asserted that this system would stop waste, and thus increase the revenue by not having to pump such a large quantity of water for daily consumption. It has been demonstrated over and over again that all waste can be stopped without the use of meters of any kind, and precisely in the same manner as that adopted by the meter advocates. This was ably described in the Journal for March 20, 1888 (p. 509). We must not reckon on the waste being stopped as a saving; for in many cases this has been already effected, and cannot be further reduced by the use of meters. An intermittent supply may be changed into the constant service night and day, without resorting to the use of meters. It is only necessary to make and enforce rules as to the fittings to be employed, and all waste may be readily stopped as before stated.

I am well aware that much adverse criticism is raised against the advocates of water supply by measure, and that the same thing occurred when the gas-meter was introduced; but although many of these indictments have become obsolete, owing to the present requirements of the people, yet much that was then said still remains, and the gas-meter is not all that we should desire. Will anyone assert that a supply by meter under the new authorities, when they acquire the undertakings, will lessen the rates paid at present? If so, I shall be glad to see the figures stated in the Journal. The claptrap of these unpractical men is sufficient to convince the general populace, who are led away by so-called retrenchment, but who never analyze the figures so as to ascertain where the reduction of 3d. in the pound has been taken from to make up the deficiency caused by the reduction in the water-rate. The consumer is looking out for the next great reform to enable him to pay less for his water under a meter system. A certain class will pay less; but will the whole community be benefited? If the consumer pays less, then the water company must suffer. The water company must be fully equipped with reservoirs, with engines in duplicate, and with an efficient staff, &c.; and it will matter but little if they should have to pump a rather less quantity of water. Again, how is the argument to apply to companies who do not pump their supply. Legislation hitherto has treated all companies alike, whilst the difference in cost is so very great. If it is a gravitation supply, and there is plenty of water, surely the best means is to allow the consumer to pay the rates, and use all he desires; but this class of supply must not be put on the same footing as when the water has to be raised 400 feet.

Of course, the use of meters may be forced upon the companies by the power of public opinion; but this latter cannot be said to be a true standard in the case of an engineering problem, any more than it would be in a medical problem. Take any company established 50 years, what would be the amount of interest paid throughout the long years of plodding, labour, and expense? I do not find any paying an average of 7 per cent. from the commencement; and I venture to assert that the meter advocates would not be satisfied with that remuneration. As a proof that they are not, the present cost of the positive meter will suffice. But some companies have paid nothing, and many only 1¼ per cent.; and it cannot be fair to place these companies under the same laws as those paying 10 per cent. It is absurd to talk of vending water by measure, as advocated by the Bill of 1884; for instead of 6d. per 1000 gallons, it should have been 2s. 6d. to recoup the companies, pay the interest on the enormous capital embarked, with the expense of maintaining the works in efficient order, and providing a pure and wholesome supply. The steady growth of the works is to be expected; but the increase of revenue must also be insisted on as a natural outcome of the labour and thought bestowed on the working of the undertaking; and legislators must be taught that the shareholders have rights to be observed as well as the consumers.

The use of meters must have the effect of making every person economize; therefore the price per 1000 gallons must be raised, or the company will be compelled to reduce the payment of dividend, which is a lawful charge equally as much as any other property, and should not be tampered with. Seeing this, the consumer cannot reap any benefit, but, on the other hand, will be restricted in the use of water, which should certainly be encouraged by all legitimate means.

It is said that meter-rates are so reasonable as to allow a considerable waste in the necessary cleansing and flushing traps, water-closets, &c.; but no consideration is given as to the public companies' dividends. This reasonable rate is to be fixed by newly-elected councillors—men having no knowledge of water-works systems, or of the difficulties and expense attendant on obtaining and distributing a pure and wholesome supply of water. At present the rating is fixed so that the occupiers of large houses assist to pay for the poor, which was the spirit in which the rating was fixed at the outset. Under the meter system, however, the rich will pay very much less, and the poor be restricted in the quantity they use; and consequently the companies would be robbed of half their present lawful support. Water sold at 9d. per 1000 gallons is at the rate of 2d. per ton; and it has to be pumped, filtered, distributed, and raised to the tops of houses for this sum. The cost of works for carrying this out cannot be diminished; therefore if the rates are less, the price must be raised. No one but an advocate of the meter system would talk of a constant supply without cisterns; for if the water was shut off for five minutes from the manufacturer of these machines, various lawyer M.P.'s, and water agitators would find employment. At Newport (I.W.) a few meters have been fixed for domestic supply; but as the Corporation lost by this system, they are now trying to abolish it, and return to the universal method of rating.

Of course, the meter system finds most favour in America principally among the works owned by corporations; but the evidence is very conflicting, and the statistics most intricate—each town making a law for itself, and binding the consumer to pay a minimum rate sufficient for all expenses, including the interest on the large outlay for meters. Some corporations vie with each other in supplying water cheaper than their neighbours, for the purpose of attraction of trade to the town; and in this case the deficiency is met from other sources. Again, in no instance is there a meter for every tapping for all purposes; but discretion is used, and rates are fixed where they are most payable, or where a loss would occur even under the minimum rate. On all sides it is admitted that there is no revenue derived by the use of meters from small consumers.

Some of the readers of the Journal may advocate that the company or corporation should provide the meter and keep it in

* See Journal, Vol. LII., pp. 632, 717.

repair, charging a price sufficient to cover the expenses of wear and tear and inspection. This is, in my opinion, the correct and only method to adopt, if meters are to be used at all. The consumer cannot be allowed to own his meter, for he will use one of the type which is cheapest to himself. But inasmuch as the pressure varies all over a town, no person can be competent to judge of the requirements of the consumer, and the existing circumstances under which the meter is to work, but the company's engineer or inspector, who has had a proper training in regard to the distribution of water throughout the town. The same time and expense are requisite for looking after a meter passing only a small quantity of water, as after one used for supplying a large quantity; and the office expenses are equally great. Every works must have a meter-testing station, so that the consumer, if dissatisfied, may send the instrument to be tested; and he should be compelled to pay the expenses of removal and testing when it has been found to register against the company.

In this question, no general rule will apply, unless to a certain extent. Many corporations would consider the propriety of selling water cheaply, so as to attract visitors and purchasers of large property. This is very well for a corporation; but in the case of a company they must pay a fair dividend, and at the same time use their customers well. If a community chooses to be taxed in other forms, and pay a low meter-rate for the purpose of attracting trade to their town, it may be admissible; but obviously this is no argument in favour of meters. By the use of meters, either in large or small numbers, the reduction in the amount of consumption and waste of water would be large; but the reduction in the revenue would be still larger. All water companies are expected to keep the whole of their mains under pressure by pumping day and night and Sundays, for the purpose of protecting the property of the consumer from fire (for which they get no payment), and to supply water for the flushing and watering of roads at a reduced rate, which in many cases is not sufficient to pay 1½ per cent. on the outlay. Then the County Council reformer comes in to insist on all works sending a supply of water at one and the same uniform rate! The whole question resolves itself into the price to be paid per 1000 gallons; the minimum, or reserve, being different in every case, according to a sliding scale, the ownership of the meters, and the rent to be paid for it. The Bill to bring this about must be entirely different from that of 1884, which was the most ignorant attempt at water-works legislation ever brought before the House.

In conclusion, perhaps I may be allowed to quote from the report on this subject of the Corporation of one of the most important cities in the United States. The Corporation of Boston state in their report: "The time has not arrived, in our judgment, for the adoption of an enlarged scheme of meter service. The occasion for what may be called a general meter service can only exist in such cities as are compelled to maintain high water-rates; or in such cities as are constrained to carry their economy of supply to the point of parsimony." This is the verdict of the greatest experts in the use of meters extant; and of a Committee who have spent more time and money in studying the question than any corporation or public authority in the world, and whose experiments and tests of meters cannot be equalled. This verdict will be admitted to be a most powerful argument against the meter system.

Removal of Electric Wires in New York.—By a recent ordinance, all the dangerous electric lighting wires in New York have been removed; the result being, says the *Daily News* correspondent, that several electric lighting companies have practically gone out of business, and given place to gas lighting, pending the restoration of their wires in a perfectly safe condition.

Chicago Water-Works.—The new water-works at Chicago, which are now well advanced, are of a very interesting character—differing totally in their design from all such works on this side of the Atlantic. The water is drawn from the lake; the intakes being situated at a distance of four miles from the shore, to which the water flows along a tunnel 8 feet in diameter driven below the lake bottom. At the intake end is a caisson 125 feet in external diameter and 53 feet high. The bottom is of timber balks, each 12 inches square, built up into a ring, and connected together by 1¼-inch bolts. Upon this has been built two concentric cylinders of steel plate, ⅜ inch thick; the space between being filled with concrete. The inner cylinder is 70 feet in diameter, forming the intake, and is connected with the tunnel, whence the water is led off to the pumping-stations, and distributed over the city.

A Strike of Stokers averted at Norwich.—An important incident in the gas workers' labour movement has just been witnessed in Norwich. It appears that a fortnight ago 100 Union men employed in the gas-works went to the Manager and called for the dismissal of 50 non-Unionists; threatening that if the demand were not complied with, they would give a week's notice to leave. The Directors refused to accede to the demand; and promptly prepared for a fight. This, however, did not come off, as not only were the notices not given, but the local Secretary of the Union sent a letter to the papers thanking the Directors for certain concessions they had made a few weeks previously. The Union men also agreed to work with the non-Unionists, and not to interfere with them in any way. The example of firmness of attitude displayed at Manchester and in the Metropolis evidently had a beneficial effect at Norwich, and averted what might have been a serious difficulty.

Technical Record.

THE CONVERSION OF GAS GLOBES INTO REGENERATIVE LAMPS.

At the Meeting of the Glasgow Philosophical Society on the 18th inst., a paper on this subject was read by Mr. D. R. Gardner, of Messrs. A. Gardner and Son, of that city.

The author began by stating that he was led up to the invention he was about to describe by his experience in connection with the consumption of smoke in boiler furnaces. Many years ago, after having been summoned for creating an alleged nuisance by smoke, he investigated the principle of consuming, or rather of preventing smoke; and he found that highly-heated air, properly applied in the furnace, was all that was necessary. He afterwards proceeded to bring this principle to bear in the production of a regenerative gas-lamp suitable for shops, halls, &c. He studiously avoided the method in which other inventors had carried out the principle of regeneration in gas-lamps, and was led to supply the air from the bottom of the shade alone, and to control the draught by means of a damper at the top of the funnel, which, by being screwed up or down, adapted the lamp for burning gas of any quality or at any pressure. In like manner he carried out the same principle in ordinary gas globes or shades.

With the view of explaining the science of increasing light for illuminating gas, the author quoted from an article in "Ure's Dictionary of Arts, Manufactures, and Mines," to show that the proper burning of illuminating gas depended upon certain physical and chemical conditions, the due observance of which was of great importance in the development of a maximum amount of light. Chief of these was the prevention of the escape of any particles of carbon unconsumed. He also referred to Dr. Frankland's Argand burner, fitted with a double chimney for the purpose of highly heating the air; the result being that when 3·3 cubic feet of gas were consumed per hour with the single chimney, 13-candle power was yielded by the gas, whereas by employing the double chimney 21·7-candle power was developed. The double chimney was tried by the author before he was aware of its previous use; but he found it to be valueless, as the double glass considerably obstructed the light, and the dust and moisture carried in by the current of air further obscured it. He then resorted to the ordinary globe, and discovered that, by materially diminishing the outlet, the flame considerably increased in size. His thoughts were at once directed towards the materials and form best suited for a cover to the shade. Asbestos was tried, by moulding or fitting it on the globe; but when a high temperature was maintained, the globes would occasionally crack. Latterly, after making various attempts to overcome this and other difficulties, the author hit upon the expedient of using small plates of mica between the asbestos and the glass shade as non-conductors of heat. Although he had subjected the shades to very severe tests, he had not since broken one. The cover might now be considered to be as simple and perfect as it was possible to make it, as it suited all qualities of gas, the different pressures, the various sizes of burners, and could be used with the present shades and gas-fittings by merely placing it on the shade and adjusting the regulator. The appliance has been patented in the United Kingdom, and will be in other countries.

The following is a brief description of the cover in the form now arrived at by the inventor:—Sheet asbestos, specially prepared for the purpose, is cut into discs varying from 4 up to 7⅜ inches in diameter, and rising ¼ inch to each size, so as to suit all the different sizes of shades. In order to hold the cover in its place, three asbestos studs are fixed on its lower surface, moving in an eccentric, which allows the cover to be most perfectly fitted. Round the lower edge there are half-a-dozen discs of mica fixed. These act as non-conductors between the glass shade and the cover. In the centre of the cover there is punched out an opening 1⅜ inches in diameter; and the disc so removed is fixed by means of a stud to the cover at one side of the opening on which it turns—thus becoming a valve to regulate the size of the aperture according to the quality and quantity of gas used.

Mr. Gardner stated that he had recently called upon Mr. W. Foulis, the General Manager of the Glasgow Corporation Gas Department, to confer with him on the invention. This gentleman at once heartily took up the matter, and volunteered to have it subjected to a thorough scientific testing photometrically by Mr. D. Terrace at the Dawsholm Gas-Works. The author then briefly referred to some of the papers on "The Economical Use of Gas" by Mr. Terrace and the late Dr. Wallace, and went on to state that the former gentleman, in showing that the improvement under consideration was not to be had from burners, said that, in testing several of the devices intended to improve the ordinary open gas-flame, he found no increase in luminosity per cubic foot of gas consumed from that given by the union-jet burner consuming 5 cubic feet per hour at 0·5 inch pressure. At this stage Mr. Gardner directed the attention of the members to a table in which were embodied the results of a series of tests made by Mr. Terrace, with the view to ascertain the loss of light with small burners and high pressure; also to a table showing the loss of light resulting from using different kinds of shades. He stated that if the extremes of the two tables were taken together, the loss of light was something like 91 per cent.

In summing-up, the author said he found from the different authorities that highly-heated air produces complete combustion, and gives an increased luminosity to the carbon contained in the

gas; and that it is necessary to retard the flow of gas at the burner. The question came to be: "Had those two points been attained by the application of the asbestos cover?" One experiment, he remarked, would be quite sufficient to demonstrate this. He caused a cloud of smoke from a piece of brown paper to enter the shade, which showed a quiet condition of the atmosphere around the flame, and consequently a retardation of the flow of gas at the burner, while the temperature of the surrounding air was raised to the point desiderated by Dr. Frankland for the combustion of the light carburetted hydrogen that passes off unconsumed from an ordinary gas-flame. Mr. Gardner declared that he had burned a number of lights with the covers on in a small room for a couple of hours, and on returning to the room from the fresh air, he could not perceive the slightest unpleasantness in the atmosphere; whereas if the shades had been without covers the air of the room would have been both disagreeable and unhealthy.

The illuminating power attained by Glasgow gas by the use of the Gardner asbestos cover had been tested by Mr. Terrace, under the direction of Mr. Foulis; and the results were shown in a table exhibited, of which the following is a copy:—

Results of Tests with Covered and Uncovered Shades and Open Flames.

Description of Globes (clear).	Tests with Union Jet Burners at 5-10ths Pressure.		Illuminating Power corrected to Five Cubic Feet.			Increase Per Cent. with Cover.	
	No.	Consumption Per Hour.	Open Flame.	Globes without Cover.	Globes with Cover.	Open Flame as Standard.	Globe without Cover as Standard.
		Cub. Ft.	Candles.	Candles.	Candles.	Per Cent.	Per Cent.
Comet	8	5·00	22·19	20·91	24·49	10·36	17·12
Squat	8	5·00	..	19·40	24·50	10·41	26·29
Nelson	8	5·00	22·25	20·25	24·61	10·60	21·53
Queen Anne	6	3·75	20·15	17·10	22·41	11·21	31·05
Do. do.	4	2·75	15·49	13·25	18·83	21·56	42·11
Squat small } 15-10ths	4	5·08	11·41	10·27	14·75	29·27	43·62
Do. large } 15-10ths	4	..	11·41	9·89	13·66	19·72	38·12
Nelson (ground, with flowers) 5-10ths	8	5·00	22·35	14·35	19·68	..	37·14
Queen Anne (clear, with fern) at an angle of 45°, at 5-10ths	8	5·00	18·88	16·81	29·08	53·76	72·70
Queen Anne (clear) at an angle of 45°, at 5-10ths	4	2·75	..	9·59	21·15	..	120·50

Proceeding, the author stated that the tests were taken horizontally, and in the most favourable conditions for the open flame—viz., with a No. 8 burner consuming 5 cubic feet of gas per hour at 0·5 inch pressure. Comparing the covered globe with the open flame, an increase of light was obtained of from 10·36 to 21·56 per cent. Then, comparing the covered with the uncovered shades, a greater difference was arrived at—viz., 17·12 to 42·11 per cent. Blackened covers were tried in order to see if the increased luminosity was due to reflection; but they also showed the same good results. Tests were made at an angle of 45°, which is about the usual position of a light in relation to the person using it, and they gave, with a covered shade and a No. 8 burner, 53·76 per cent. more light than the open flame; whereas on comparing the light from the covered shade with that from the uncovered shade, 72·70 per cent. more light was obtained. With a No. 4 burner the increase of light, by using a covered shade, rose to as much as 120·5 per cent.

In conclusion, Mr. Gardner said that, looking at the immense daily waste of gas (amounting, according to the late Dr. Wallace, to £130,000 per annum for Glasgow alone, fifteen years ago), he thought it would be well for the Glasgow Corporation Gas Trust to lead the way in promoting its economical consumption, by instituting a Lighting Department that would superintend the burning of the gas, and not allow the consumers to waste so large a percentage of it.

There was very little time allowable for the discussion of the subject raised by Mr. Gardner's paper; but, as Mr. Foulis was present, he was called upon by the Chairman to make a few remarks. This gentleman said he had been much interested in the invention, the results of the testing of which had greatly surprised him. The gas authorities of the city and himself were always ready to encourage every feasible attempt to improve the illuminating effect of the gas supplied to the consumers; and in this spirit he had authorized Mr. Terrace and his assistant (Mr. Duncan) to test Mr. Gardner's invention most thoroughly. The results were seen both in the table exhibited and in the lamps with which Mr. Gardner had been experimenting that evening. He (Mr. Foulis) was not, however, yet prepared to admit that the whole of the effect, if even any appreciable amount of it, was obtained by the increased heat of the air used in the combustion of the gas. He rather thought it was almost wholly due to the quietness of the atmosphere within the shade. Having alluded to the experimental investigations which Mr. John Methven had lately been conducting in a somewhat similar direction, but with Argand burners and the use of chimneys necessary for them, he remarked that he had been deeply interested in Mr. Gardner's paper and the experiments, and felt that the Society was much indebted to him for having brought the subject before them.

MECHANICS' ALMANACS.—The "*Mechanical World* Pocket Diary and Year Book for 1890" contains, in addition to the useful collection of notes and formulæ for engineers, draughtsmen, mechanics, and others, which have appeared in previous issues, a large amount of additional matter of a thoroughly practical character, which will increase its value to those for whom it has been compiled. It is published by Messrs. Emmott and Co., of Manchester and London. Another little book of the same kind is Calvert's "Mechanics' Almanac and Workshop Companion," which has now reached its seventeenth year of publication. Previous issues of the work have been noticed in our columns; and therefore it is only necessary to say that the present contains a quantity of information specially instructive and entertaining to artizans and handicraftsmen. It may be had of Messrs. J. Heywood and Co., of Manchester and London; or direct from the author, 99, Jackson Street, Manchester,

FORMATION OF COAL AND CARBONACEOUS MINERALS.

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[From the Proceedings of the Australasian Association for the Advancement of Science.]

In most chemical manuals the production of coal and similar carbonaceous minerals from cellulose is assumed, and equations are given, showing its transformation into coal of different varieties by the elimination of oxygen and hydrogen as water, carbon and oxygen as carbon dioxide, and carbon and hydrogen as methane. These are known to be evolved during the decomposition of vegetable matter, and are assumed to be given off by cellulose; and as this has a high molecular weight, and as any acquired number of molecules may be used, the equations look very pretty. One can subtract any acquired number of molecules of CO_2H_2O and CH_4 from $C_6H_{10}O_5$, or a multiple of it, and obtain a residue corresponding to anything, from free carbon to cellulose itself. These views are again set forth in one of the latest chemical works bearing on the subject—viz., Wanklyn's "Gas Engineer's Chemical Manual." In connection with this, I would point out that in most coals the woody fibre, which contains the greater portion of the cellulose in modern plants, is represented by almost pure carbon, forming the so-called "mother of coal," or mineral charcoal. As cellulose was so converted, it is an untenable position that other portions of the same substance should, under the same conditions, be converted into bituminous matter. On the other hand, mineralogists and geologists generally lay great stress on the conditions under which the deposit of coal was formed, and refer particular varieties to different horizons as a reason for their different composition and properties. This can be made to agree with the chemical hypothesis mentioned, as it may be said that different quantities of the products would be formed under varying conditions.

There are others who acknowledge that there are at least three conditions which modify the composition of the mineral. Thus, Percy recognizes the fact that difference in the composition of vegetable matter due to resinous bodies, &c., may, by increasing resistance to decomposition, tend to preserve vegetable structure (*vide* "Fuel," p. 270). Dana says: "Coals were once beds of vegetation, analogous in most respects to the peat beds of modern times" (*vide* "Mineralogy," p. 758); and on the succeeding page: "Between excluded and imperfectly excluded air and of pressure from heavy superincumbent earthy beds and little or no pressure, lie the conditions which attended the origin of the various kinds of coal, and determined, in *connection with the nature of the vegetation itself*, their transformation in progress." From various observations, the writer has come to the conclusion that the words put in italics by himself are of more importance than is usually assumed, and that this idea is probably the most important of all. This condition is placed first in a sentence in Ronalds and Richardson's "Knapp's Technology" (Vol. I., p. 765), where it says: "The varieties of coal may depend on the nature of the plants that composed it, the varied circumstances attending their deposit, or the varied conditions under which the beds have subsequently been placed."

My thoughts were first directed to the probable comparatively great importance of the original composition of the plants through examining a number of brown coals from New Zealand, Victoria, Western Australia, and New South Wales, and which I found could be divided into four classes:—

(1) Those containing fossil resin (retinite), distributed through them in grains from the size of pin-heads to that of marbles, and amounting sometimes to 20 or 25 per cent. of the mass.
(2) Those containing iron pyrites, but no retinite.

(3) Those containing neither retinite nor pyrites, but having much sulphur in organic combination

(4) Those without retinite, pyrites, or much sulphur.

Subjected to distillation, the first and last evolved but little sulphuretted hydrogen; the second evolved much of this gas under the conditions of high temperature; and the third, both at high and low temperature.

If we consider these varieties of imperfect coal, it appears probable that, had they been subjected to conditions such as would convert them into coal, the results would be very different for each, although the conditions were the same. The first is evidently produced from highly resinous vegetation, and would probably yield bituminous coal, and the resin gives an aromatic odoured distillate on quickly heating; but the amount of resin available was too small to go into the matter of the products. The second, from non-resinous vegetation (the pyrites being formed by infiltration), would yield a coal like the stinking coal of Lancashire or the brassy coal of some of the Scotch mines. The third it seems probable was produced from vegetation containing much sulphur, such as we find in our modern Cruciferæ; and to this I know of no corresponding true coals. The fourth would correspond to the splint, cherry, and other less bituminous coals.

Again, the deposit of kerosene shale or torbanite at Joadja Creek consists of three distinct layers, separated by almost imperceptible partings, and yet everywhere perfectly distinct. The seam is composed of, first, a layer of splint coal containing a rather large proportion of ash; second, a layer of shale, covered; third, a layer of bituminous coal of fair quality. In this case it appears that the three layers were deposited in orderly succession, and that all must have been subjected to the same conditions since deposition, and yet the ultimate products are entirely different. It may be observed, in passing, that these deposits of torbanite, both in New South Wales and Scotland, where one only has been found, seem to have been originally laid down in irregularly lenticular depressions; and observation has indicated that they have never been subjected to excessive pressure, as wherever the "cover" exceeds two or three hundred feet the torbanite is found changed into a carbonaceous slaty mass. It is evident that the differences in the three layers in this seam cannot be ascribed to any other causes than an originally radical difference in the vegetation forming them. Torbanite, Boghead, or kerosene shale, has been legally classed as coal, and it is usually classed with cannels although it is very different. Thus Wanklyn (*loc. cit.*) says: "The following is an analysis of one of the richest cannels—viz., Boghead [the original torbanite of Scotland]. The large proportion of mineral matter (21 to 22 per cent.) will not escape notice; and it will be perceived that Boghead consists of mineral matter saturated with a hydrocarbon containing a larger proportion of hydrogen than there is in benzene (C_6H_6)." At Joadja Creek the mineral matter falls as low as 6 per cent., and it is difficult—I should say impossible—to think of 6 parts of mineral matter "saturated" with 94 parts of hydrocarbon, whilst the overlying coal and sandstone and the underlying coal and sandstone are absolutely free from it.

The old alchemists used to subject everything organic to destructive distillation, and divide it into water, phlegm, and *caput mortuum;* and perhaps some information may be gleaned from this industry as now carried out on a large scale. This information is, however, not very direct, owing to the effect of varying temperatures in process, so that the subject is divided two—viz., high temperature (*i.e.*, gas-making), and low temperature (*i.e.*, oil-making). In the first the liquid and solid hydrocarbons obtained are mostly composed of the aromatic series, whilst those of the latter belong to the fatty series. The gaseous products may be disregarded in both cases, as they are similar; being hydrogen, methane, and some of the lower olefines, mixed, in the case of high-temperature work, with the vapours of aromatic hydrocarbons held in gaseous solution.

In all high-temperature work more gas is produced than in low, and carbon is deposited, whilst aromatic hydrocarbons are formed, as benzol from polymerization of acteylene below a red heat, and its conversion by elimination of hydrogen into naphthalene at a red heat, whatever the source of the original hydrocarbon. If, however, we look at what is done commercially with various coals and shales, we shall find that they are not used indiscriminately, but some for one purpose, some for another, according to the value of the products. The statements sometimes found in books are often rather confusing. Thus, Knapp says: "When submitted to destructive distillation, all varieties of coal yield the same solid, liquid, and gaseous products, consisting of coke, tar, ammoniacal liquor, benzol, naphtha, naphthalene, paraffin, paraffin oil, and illuminating gas, the proportions of which vary with the quality of the coal and the temperature employed" (Ronalds and Richardson's "Knapp's Technology," Vol. I., p. 273). Later writers recognize some difference; thus, Mills says: "Cannel tars are poorer in aromatic compounds than are bituminous tars" ("Manualette of Destructive Distillation"); and Lunge: "We may say generally that the tars from peat, brown coal, and bituminous shale consist principally of hydrocarbons of the 'fatty series,' wood tar of phenols and their derivatives, coal tar of aromatic hydrocarbons" ("Distillation of Coal Tar," p. 3). Again: "Brown coal tar, as well as that obtained from peat and bituminous shale (and formerly from the Torbane Hill mineral) is manufactured for its own sake as a principal product, and forms the basis of the West European manufacture of mineral oils and paraffin. The other products of the destructive distillation of such more recent fossils possess very little or no value, except in the case of some very dense coal-like brown coals, which furnish good coke and good gas, but no mineral oil."

These quotations show the general drift of opinion amongst those intimately connected with the subject of distillation, as I have also been more or less for thirty years. There is a radical difference in the substance submitted to retortings, and although the fatty hydrocarbons are more or less converted into gas and aromatic hydrocarbons by a high temperature, the transformation is always incomplete, and I believe that the difference in products arises chiefly from the original differences of the vegetation of which the coal or shale was formed. Of the various mineral fuels, some (as anthracite and splint and cherry coals) are never distilled, the products being of no value. Coking coals (in contradistinction to gas coals, which are used for making both gas and coke) are distilled for the sake of the coke; and a few years since it was anticipated that great results would be obtained by the use of Simon-Carvès and other improved ovens, by which the tar could be collected. But valuable aromatic hydrocarbons were present in such small proportion that the anticipations were not realized. Bituminous gas coal yields tar rich in benzene, anthracene, and other valuable aromatic hydrocarbons, and practically none of the fatty series; and tar distillers object to the use of shale along with it, as they introduce these.

Cannel used alone in gas making, as in Edinburgh and Glasgow, gives a tar yielding less benzene and its homologues than that from bituminous coal, and these are mixed with a notable proportion of fatty hydrocarbons. From this tar olefins and paraffins, boiling from 20° to 100° C. are obtainable, and of the liquid obtained at the boiling-point of benzene, only about two-thirds consist of that substance which crystallizes out when the mixture is placed in ice and salt. On distilling cannel tar, only about 10 per cent. of oils are obtained, which are lighter than water—about 35 per cent. of the tar being heavier; and although the lower fractions contain notable quantities of fatty hydrocarbons, these gradually decrease until the heavy pitch oil contains mere traces of paraffins. I speak here of the low heats used in gas making thirty years since; with the high heats employed now-a-days the quantity of light hydrocarbons is much smaller—not above 4 to 5 per cent. On the other hand, cannel has been little used for low-temperature work (except Leeswood cannel, which was what we should call in Sydney kerosene shale), although the amount of volatile hydrocarbons it contains ranges from 40 to 45 per cent., and even higher in Scotch cannels, where shales yielding 13 per cent. of oil are worked. In my experience cannel oil is troublesome to purify, yielding much tar (polymineriezed acetylenes, &c.) to sulphuric acid.

Shale is very rarely used alone for making gas; but it is so used for the gas for the railway carriages on our Government railways. I tried to procure a sample of the tar; but found that unfortunately it could not be kept separate from the tar from bituminous coal, from which gas is also made. The mixed tar was just heavier than water, and particularly mobile for a tar. Subjected to distillation, the process being carried so far that the residue in the retort set to a rather hard pitch on cooling, it gave a distillate wholly lighter than water. This distillate treated by reagents gave the following percentages by bulk:—

8·5	per cent. to concentrated sulphuric acid—basic bodies and polymineriezed acetylenes.
31·9	per cent. sodium hydrate—phenols and conjugate acid bodies formed by previous treatment with acid.
46·7	per cent. to nitric acid—aromatic hydrocarbons and olefins.
12·7	per cent. unattacked—paraffins.
99·8	

As the shale used gives on low-temperature distillation a refined product containing paraffins to olefins in the ratio of 3 : 7, the 12·7 per cent. above would give 29·6 per cent. of olefins. This, added to 12·7, gives 42·3 per cent. of fatty hydrocarbons, and subtracted from 46·7 gives 17·1 per cent. of aromatic. The amount of phenols extracted by soda from coal tar is about 6 per cent. This added at the same rate to the 17·1 per cent. of aromatic hydrocarbon would give 18·2 per cent. of coal-tar hydrocarbons; and we should then have 18·2 coal hydrocarbons to 42·3 of fatty or shale hydrocarbons, which is in the ratio of 1 : 2·32. I am informed that the quantities of material used in the gas-works are 9½ tons of Newcastle coal and 7¾ tons of shale per week; and as coal gives approximately 10 gallons of tar per ton, while shale averages about 27 gallons, this would give the following ratios:—

Coal to shale as	1 : 0·82
Coal tar to shale tar as.	1 : 2·29

This shows a tolerably close approach to the ratio of hydrocarbons actually found. In this, only the more stable hydrocarbons have been taken into consideration; but, look at the matter how we may, there seems no doubt that the fatty hydrocarbons remain true to their type, and are much less readily converted into the higher carbon aromatics than is usually assumed under the conditions of high temperature distillation as carried out on a large scale. This is further shown in the fact that although numbers of inventors have proposed processes, and have taken out patents for the conversion of the comparatively low-value fatty hydrocarbons into the higher-value aromatic ones, by passing the vapours through heated tubes and otherwise, none of these have been commercially successful, in consequence of the loss being great in the form of lower fatty hydrocarbons, and the yield of aromatic therefore small.

The C_6 formula of cellulose has been thought to connect it with the aromatic series, but all transformations convert it into hydrocarbons, alcohols, and acids of the fatty series. On the other hand, ligno-cellulose, as found in jute and other bast fibres with a higher percentage of carbon and a lower percentage of oxygen, does yield aromatic compounds—as hippuric acid during its digestion by herbivora—and by its giving pyrocatechuic acid by chlorination, and subsequent treatment of the chlorinated product by fusion with potash. Ligno-cellulose, however, treated with nitric and sulphuric acid, yields no aromatic nitro-derivatives, so that the benzene nucleus must be absent. This seems to connect ligno-cellulose with those coals which do not yield valuable aromatics during distillation—that is, coking, steam, and splint. I do not enter further into the consideration of those coals at present.

I shall now refer to the three varieties of coal usually subjected to distillation for their products, and shall take first bituminous coal, used for gas making, and yielding valuable aromatic hydrocarbons as a bye-product. The published analyses of coals are of little value for comparison for the purpose in hand, as these analyses have been made from average samples of different seams to determine their commercial value, and so do not take into account the fact that almost every coal is made up of a mixture of heterogeneous materials, varying from nearly pure carbon to substances containing large percentages of hydrogen and oxygen. Even in the different bands into which coal seams are divided by partings, the average of each band may differ very considerably from the average of the whole. Thus in the six bands of a coal seam which I recently examined, the ratio of volatile hydrocarbon to fixed carbon was in each band as follows:—No. 1, 1 : 1·977; No. 2, 1 : 2·750; No. 3, 1 : 2·349; No. 4, 1 : 3·075; No. 5, 1 : 2·260; No. 6, 1 : 1·122.

It appears doubtful whether much information could be obtained from making ultimate analyses of the separated constituents of any coal (except in the case of the substance No. 1 below, which I shall examine further), and I have confined myself to determining the hydrocarbons driven off at a cherry-red heat from different materials in the same block of coal.

In some Newcastle coal, colliery unknown, a piece was separated into jet-black bituminous matter, which broke easily into more or less cubical fragments, and a dense hard coal with a rather pale lustre. Subjected to heat, the bituminous portion fused together, forming a swollen bright coke, whilst the other did not fuse, but shrank slightly, and gave a coke of the same shape as the original, or nearly so, and silvery. The ratio of volatile matters to fixed carbon was—

	Volatile.		Fixed Carbon.		Ash.
No. 1	1	:	2·012	..	0·52 per cent.
„ 2	1	:	3·455	..	9·81 „

The ash in No. 1 was composed almost entirely of ferric oxide; that of No. 2 was greyish.

A piece of Stockton coal, which is considered one of the best of our Newcastle coals for gas making, similar in appearance to the first, gave—

	Volatile.		Fixed Carbon.		Ash.
No. 3	1	:	1·870	..	1·12 per cent.

In this case also the ash was almost entirely composed of oxide of iron. This coal is bituminous to such an extent that I could not get enough non-bituminous to examine by itself.

The coals of our western districts are much less bituminous than in the northern, and the bituminous matter is in very thin layers. From No. 4, the bright black portion of a piece of Lithgow Valley coal, and from No. 5, the contiguous dull portion, I obtained—

	Volatile.		Fixed Carbon.		Ash.
No. 4	1	:	1·889	..	1·07 per cent.
„ 5	1	:	2·248	..	5·63 „

No. 4 swelled up and united into a single mass, but did not so entirely lose its original outline as in the case of No. 1; and it was lustrous black, not silvery. The ash consisted chiefly of alumina with a little oxide of iron and some traces of silica. In No. 5 the coke was shrunk, and of the same shape as the coal. There were some bright black thread-like bands in No. 5 which it was impossible to remove, and these probably raised the percentage of volatile matter. I could not avoid this, as I wished to have the portions of coal immediately contiguous.

These results seem to indicate that the bituminous part arises from altered resin, from the low ratio of fixed carbon, and the low percentage of ash; in the case of those from Newcastle, from oxide of iron, which could be introduced by infiltration, as could also be the case with the alumina in the Lithgow Valley, as the water of the overlying Hawkesbury sandstone generally contains sulphate of alumina in solution.

In connection with a coal from Mittagong, the analysis of which was published in the "Annual Report of the Department of Mines" in 1878, I made the following remark, which has been reproduced in Professor Liversidge's "Minerals of New South Wales":—"The bright lines of fracture were marked by numerous lens-shaped cavities 0·05 to 0·10 inch in greater diameter, generally filled with a brownish pulverulent carbonaceous matter. These were apparently the impressions and remains of seeds, and they showed traces of a dense cortical layer. The bituminous matter on heating glowed, emitted a smoky odour, and burned away completely." These seeds were quite absent except in the bright layers. Now, if the seeds fell and were enclosed in resin, germination would be prevented, and they would be preserved; whilst if they fell in decaying vegetable matter, all traces of them would be lost. I conclude, therefore, that the bituminous coals yielding low and valuable hydrocarbons on distillation are originally derived from aromatic resin-bearing plants, the resinous ligno-cellulose of which contributed to the result; whilst the cambium or more cellulosic portions were mostly lost by decay—a little being converted into mineral charcoal. We can see the preservation of resin in retinite and also in the more recent Kauri and grass-tree gums, where the cellulose has often disappeared.

Cannel.—I have no analysis of my own of this mineral, but give below the ratio of volatile matter and fixed carbons from two analyses given in Percy's "Fuel" and one from "Watts's Dictionary." In nearly all books, analyses of true cannels are mixed up with those of torbanite or kerosene shale from Bathgate and elsewhere. The Lesmahagow is a true typical cannel from the middle ward of Lanarkshire:—

	Volatile.		Fixed Carbon.		Ash.
Lesmahagow	1	:	1·495	..	6·03 per cent.
Wigan	1	:	1·304	..	2·40 „
Mold.	1	:	1·188	..	—

Cannel differs from bituminous coal in being of a nearly uniform texture, in which it resembles torbanite, but differs from the latter in every other way. From the character of the hydrocarbons it yields on distillation, it seems probably derived from adipo-cellulose, and ligno-cellulose; the former having considerable development in plants, which from the comparative uniformity of the mineral, were probably of small size.

Torbanite or Kerosene Shale.—In the coals and cannels the volatile hydrocarbons are always less than the fixed carbon; whilst in the shales this ratio is always reversed, and that irrespective of the amount of ash present. The following are five recent determinations of mine. The carbon, being the smaller, is taken as No. 1—not the volatile matter, as in the coals:—

	Carbon.		Volatile Hydrocarbon.		Ash.
No. 1. Joadja Creek	1	:	16·908	..	6·17
„ 2. Source unknown	1	:	12·500	..	6·20
„ 3. Murrurundi	1	:	8·625	..	21·32
„ 4. „	1	:	6·041	..	40·88
„ 5. United States	1	:	2·561	..	7·95

Nos. 1 and 2 were beautiful fine-grained shales, with a velvety lustre and pale streak; No. 3, fine-grained brownish, scarcely velvety; No. 4, coarse-grained brownish, dull; and No. 5, black, dull—streak dark brown, almost black. It will be observed that the ratios in these shales differ widely, and also that the percentage of ash has a great range; but the value of the shale for distillation, either for oil or gas, appears to depend more on the ratio of hydrocarbons to fixed carbon than upon the quantity of ash. Thus, No. 3 is a shale much superior; whilst No. 4 is very little inferior to No. 5, although it contains more than five times as much ash. I refer to the quantity of gas or oil yielded. If distilled for oil, No. 5 would yield a very bad quality, the distillate containing much tar. This shale approaches in appearance the outlying portions of the better shales where they have been pinched under heavy cover.

Looking at the ultimate composition of shale in conjunction with the yield of fatty hydrocarbons, I was at first inclined to consider it as a product of adipo-cellulose. The following are analyses—first, of torbanite from Bathgate, given in "Watts's Dictionary;" second, of shale from Hartley, by Professor Liversidge, which I have calculated free from ash, and for comparison I repeat that of adipo-celluloses in the third column.

	I.		II.		III.
Carbon	79·6	..	79·67	..	73·66
Hydrogen	11·2	..	12·92	..	11·37
Oxygen, nitrogen, and sulphur*	9·1	..	7·41	..	14·97
	99·9	..	100·00	..	100·00

I subjected some carefully-selected cork in thin shavings, as the nearest substitute for adipo-cellulose, to a rapid red heat, and also pure cellulose, and obtained the following ratios:—

	Fixed Carbon.		Volatile Matter.
Cork	1	:	5·245
Cellulose	1	:	7·916

As under no conceivable conditions could the ratio of volatile matter be increased during the conversion into mineral, the similarity in composition goes for nothing.

It has been suggested by someone that the shales are the products of resinous spores of some plant. From the persistent fatty products of distillation I think resin must be abandoned, as resins pass more to aromatics. It appears to me more probable that shale comes from some oil or wax producing plant—more likely the latter, in view of the considerable yield of solid paraffin.

The shale at Joadja Creek is very uniform in texture. There is here and there a star-like speck of so-called jet, and rarely a ribbon-like piece of the same running through a block—perhaps an inch or so wide, and barely an eighth of an inch thick. As there is bituminous coal above, these may represent resinous roots. At Joadja there is a ligno-cellulose coal below, a wax shale in the middle, and a resinous ligno-cellulose coal above.

Addendum.—Since writing the above paper, I have found in my notes an analysis of the best Joadja Creek shale, for which I had before looked in vain. In the first column is given the analysis; in the second, the carbon, hydrogen, and oxygen only, eliminating the other ingredients as extraneous; in the third, the numbers

* The sulphur and nitrogen are very small in these shales. The only difference is an increase of carbon and a decrease of oxygen in the shales.

for the formula $C_{54}H_{54}O_2$—that is, a paraffin with 4H replaced by 2O (calculated).

	I.		II.		III.
Carbon	75·32	..	81·10	..	C_{54} 80·95
Hydrogen	12·05	..	12·97	..	H_{54} 12·69
Oxygen	5·49	..	5·93	..	O_2 6·33
Nitrogen	0·28	..	—	..	—
Sulphur	0·31	..	—	..	—
Ash	6·55	..	—	..	—
	100·00		100·00		

Pyrites was observed in the shale, and was probably the source of the sulphur.

I do not attach much importance to the formula obtained, as the organic matter of shale is not a pure substance, though I think an approach thereto. For comparison, there are given below some analyses of waxes. First, myricin or myricyl-palmatate (calculated); second, ceroxylin or palm wax, the average of three analyses by Boussingault, Lewy, and Teschemacher ("Watts's Dictionary," Vol. I., p. 837); third, carnabau wax, by Lewy ("Watts's Dictionary," Vol. I., p. 805); fourth, occuba wax, by Lewy ("Watts's Dictionary," Vol. IV., p. 173); and fifth, tristearin (calculated).

	I.		II.		III.		IV.		V.
Carbon	79·31	..	80·74	..	80·30	..	74·0	..	76·8
Hydrogen	13·22	..	13·26	..	13·00	..	11·3	..	12·3
Oxygen	7·47	..	7·00	..	6·70	..	14·7	..	10·9

Occuba wax (No. 4), the product of a plant growing in marshy places in South America, is not a true wax, but a mixture of solid fats.

It seems evident that the organic matter of shale, if produced, as I think probable, from a vegetable secretion, must have been so produced by the elimination of hydrogen and oxygen in the form of water, with probably elimination of hydrogen also by atmospheric oxygen, and could not arise from either of the last two, which contain less hydrogen; and still less could it arise from fats of lower molecular weight than tristearin, whilst it is possible from the waxes. This is more clearly seen if in Nos. 4 and 5 the hydrogen and oxygen are calculated for a quantity of carbon equal to that in the shale thus:

	IV.		V.
Carbon (as in shale)	81·10	..	81·10
Hydrogen	12·39	..	12·98
Oxygen	16·11	..	11·52

The first shows less hydrogen than the shale; the last, an equal quantity. But in both there is a large percentage of oxygen to remove hydrogen, which is not the case with the waxes, in which, indeed, the oxygen is rather deficient, which deficiency could be supplied by atmospheric oxygen. The objection to derivation from fats applies with even greater force to the derivation from amber (succinite) and similar mineral resins, probably little altered in constitution—a connection claimed by Dana in Bathvillite ("Mineralogy," p. 742), as amber contains much less hydrogen than Bathvillite or shale.

The organic matter of the shale of this country is evidently a very stable body. It is almost absolutely insoluble in naphtha, carbon bisulphide, and similar menstrua. It is scarcely acted on by exposure to the weather, as when for years subjected to fierce sun in summer, frost in winter, and rain at all times, it only becomes slightly brown on the immediate surface. Long-continued boiling with caustic alkali dissolves from the powder only a trace of humus-like matter; and fusion with caustic potash for two hours gives a similar result. Amber, however, is soluble in alkalies. The bituminous matter of coal is insoluble in solution of caustic potash; but fusion with potassium hydrate renders it largely soluble in water. In this respect it is different from the "jet" mentioned above, which is insoluble in such menstrua as carbon bisulphide, &c., in caustic potash solution; and long fusion with caustic potash gives no more soluble matter than is obtained from the shale itself. This "jet" subjected quickly to a cherry-red heat gives—

Volatile matter	41·12
Carbon (left as a highly intumesced bright coke)	55·80
Ash	3·08

The ash was reddish-coloured from the presence of oxide of iron. The immediately adjacent shale gave 9·16 per cent. of white ash, whilst the volatile matter was 83·62 per cent., and the fixed carbon 7·21 per cent.; indicating a radically different original constitution from the jet, although in some respects that was different from the bituminous matter of coal.

THE COLORIMETRIC METHODS FOR DETERMINING NITRATES IN POTABLE WATERS.

A recent issue of the *Chemical News* contained a note on the above subject by Dr. S. Rideal, Lecturer on Chemistry at St. George's Hospital. The author prefaced it by explaining that having had occasion to estimate the amount of nitrates present in some exceptionally pure waters, he had an opportunity of comparing the results obtained by the well-known colorimetric estimation, based on the formation of ammonium picrate, and commonly called the "phenol sulphuric acid" method, with one described by Mr. S. C. Hooker, in which the intensity of the green colour produced by the addition of a solution of carbazol to the nitrate solution, was a measure of the amount of nitric acid present. Although the former of these had been known for some years, and the method of performing the operations was not very different from that originally proposed, Dr. Rideal considered the details of sufficient interest to justify their publication. The note was as follows:—

The solutions required are: (1) Standard potassium nitrate solution, containing 0·7215 gramme of the pure crystallized salt in a litre of water, or 1 c.c.=0·0001 gramme of nitrogen; (2) phenol sulphuric acid solution, prepared by dissolving 15 grammes of pure crystallized phenol in 92·5 c.c. of pure redistilled sulphuric acid, free from nitrates, diluted with 7·5 c.c. of water. In addition to the above solutions, pure strong redistilled sulphuric acid and dilute ammonia solution are also required.

The process adopted was as follows:—A known volume of the water (100 c.c. or 25 c.c., according to its supposed richness in nitrates) is evaporated to dryness in a porcelain dish. To the dry residue 1 c.c. of the phenol sulphuric acid is added, and then 1 c.c. of pure water and 3 drops of strong sulphuric acid, and the mixture gently warmed. A distinct yellow colour thereupon appears if the water contains any appreciable quantity of nitrates. The contents of the dish are next diluted to about 25 c.c., and ammonia added in slight excess. The solution is poured into a narrow Nessler tube (14 in. by 1 in.), the dish washed, the washings added to the liquid in the tube, and the whole diluted to the 100 c.c. mark. The colour of the solution is roughly judged, and is then imitated by repeating the operation with the standard potassium nitrate solution, the quantity of which may vary from 6 c.c. for bad waters to 0·1 c.c. for a water fairly free from nitrates.

Under the above conditions, the method yields very good results, but care must be taken, if the preliminary evaporation is not conducted over a water-bath, not to heat the solid residue obtained; and also, after adding the reagent and acid, the mixture must only be very gently warmed.

The phenol sulphuric acid solution should be prepared some little time before use, as the fresh solution imparts a faint greenish tinge to the yellow of the ammonium picrate, which may mislead the eye accustomed to the ordinary tints obtained by this process. It was found impossible to estimate the colour by means of solutions of ammonium picrate; but Lovibónd's tintometer was not tried.

In the carbazol method, the standard potassium nitrate solution and pure sulphuric acid are also required as well as the following special reagents:—(1) Sivler sulphate solution containing 4·3945 grammes per litre, or one in which 1 c.c. will precipitate 1 part of chlorine per 100,000 from 100 c.c. of water. (2) Aluminium sulphate solution free from chlorides and iron, 5 grammes per litre. (3) Carbazol solution, consisting of 0·6 gramme of carbazol dissolved in glacial acetic acid, and the solution then made up to 100 c.c. with the glacial acid. For use, 1 c.c. of this solution is withdrawn by means of a pipette, and mixed with 15 c.c. of pure re-distilled sulphuric acid.

It was also found advisable to prepare, as the author recommends, a series of solutions containing 0·03, 0·05, 0·07, &c., parts of nitrogen per 100,000 from the standard nitrate solution by diluting with water. The process is as follows:—To 100 c.c. of the water, the amount of chlorides in which has first been ascertained, sufficient of the silver sulphate solution is added from a burette to precipitate all the chlorides. To this solution, containing the silver chloride in suspension, 2 c.c. of the aluminium sulphate solution is added, and the whole made up to a convenient bulk; 110 c.c. in the case of waters containing 1 to 6 parts of chlorine per 100,000. The solution is then filtered, and 2 c.c. of this filtrate are taken for the nitrate estimation, and, of course, the amount found must be calculated from the diluted bulk of the solution. To the 2 c.c. of the filtered water contained in a test-tube, 4 c.c. concentrated sulphuric acid is added, and the mixture well cooled. Then 1 c.c. of the carbazol solution in sulphuric acid as above described is added, and a bright green colour appears in a few moments if nitrates are present. The amount of nitrate is roughly gauged from the colour produced, and 2 c.c. of the standard nitrate solution, considered to be equal to it, is placed in a second test-tube, and the operation repeated with it and a fresh 2 c.c. of the water under examination at the same time. If the tints are not similar, a fresh comparison must be made, and in every case it is necessary to repeat the operation with a fresh quantity of the water, so that the colours may be developed as nearly as possible simultaneously.

The author stated that 0·0006 milligramme of nitrogen as nitrate may be detected by the carbazol method. The removal of chlorides is necessary for accurate results, but the filtration does not take much time when aluminium sulphate solution is added as described. As the waters under examination were free from iron, he had no opportunity of noticing the effect of the presence of iron.

The following table shows the amount of nitrates found in five waters of very different character by the two processes:—

Nitrogen in Parts per 100,000.

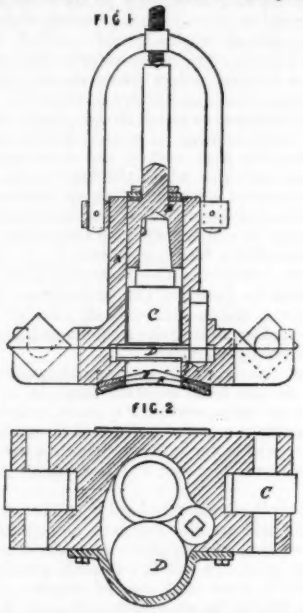
Sample.	Phenol Sulphuric Acid.		Carbazol.
1	0·025	..	0·0247
2	0·050	..	0·0450
3	0·200	..	0·2090
4	1·400	..	1·3800
5	1·690	..	1·6500

ELECTRIC LIGHTING SCHEME FOR MANILLA.—The Municipality of Manilla are about to abandon the present system of lighting the city by petroleum lamps, and adopt electricity instead. The total distance to be lighted will be about 63 miles.

Register of Patents.

DRILLING AND TAPPING AND INSERTING FERRULE TAPS AND PLUGS IN GAS AND WATER MAINS AND FIXING SADDLE BACKS ON MAINS.—Ruscoe, J., of Hyde. No. 15,727; Nov. 1, 1888. [6d.]

This apparatus consists of a cylinder or stand to be fixed on the mains, and held thereon by means of chains passing round the mains, tightened up by screws on each side. Between the stand and main there is a separate saddle-piece with leather or other packing to form a water-tight joint between the stand and the main. The cylinder is bored out from the top to a seating near the bottom of the cylinder, immediately



between which is a cavity or space prepared for, and in which, a disc valve can slide to a dead joint, and thus effectively shut off, and (when the main is drilled) prevent any water or gas rising above it and upwards in the cylinder. The valve is actuated by an external handle, having a defined position indicating when the valve is opened or closed. This chamber is made water or gas tight by means of a cover having faced joints and set screws. Turned chucks are made to slide in the bored cylinder, which chucks have a ring of packing to still further fill the cylinder and prevent any escape. The chucks are made hollow at the lower end, to hold the special drills and taps, and ferrule taps, which being truly chucked and concentric in action are positive in their operation. The external part of the cylinder has a bracket or lug on each side, to which is attached a strap, or bridle, or bow, having a central boss with a feeding screw passing through and impinging at its point upon the chuck, upon the square of which is fixed a rachet brace. As the chuck is worked down, the screw is brought down also as a feed, which motion can be reversed at pleasure. The ferrule tap is made with a loose screw, cone, or plug, working by means of a cross-handle below the outlet branch when the water is shut off, and being drawn above the branch when water can be passed along the service-pipes. For large services or branch mains, the cylinder or stand is converted into a fixed saddle-back secured to the main by set screws, bolts, or straps. The saddle-back is bored out to receive specially-made cup drills; and the disc valve is used here as well.

Fig. 1 is a sectional elevation of the main-pipe drilling machine; and fig 2, a section.

A is a cylinder bored out perfectly true; B a turned chuck to fit A, on which packing held in position by a nut and washer. C is a tap held in position by the chuck. D is a disc valve when closed. E is a saddle on which is packing F. Fig. 2 shows the disc valve open.

PRODUCTION OF COMBUSTIBLE GASES.—Thwaite, B. H., of Liverpool, No. 16,970; Nov. 22, 1888. [8d.]

This invention refers to a method of producing combustible gases in ordinary retorts, such as are usually employed in the making of illuminating gas.

Fig. 1 is a back elevation of a bench of retorts constructed according to this invention; and fig. 2 is a front elevation of same.

All the retorts A, A^1, A^2, are connected to each other by pipe-connections, rising from the upper ends of the retorts, and provided with rotary valves B, B^1, B^2. Any one of the set of three retorts can be worked in conjunction with one or more of the other retorts, by a simple regulation of the valves—for example, the gases from A can be made to flow through the retort A^1 by simply opening the valve B, closing the valve B^2 and opening the valve B^1, and closing the valve C in the ascension-pipe. The gases from A^2 can be made to flow through the retort A^1 by closing the valve B, opening valves B^2 and B^1, and closing the valve C^2 in the ascension-main. The gases from the retort A^1 can be made to flow through either retort A^2 or A, or through both retorts, by closing the valve C^1 in the ascension-pipe, and opening the valves C^2 and C in the ascension-pipes.

The steam (preferably superheated, by being led through a superheater coil in the flue leading from the retort bench to the chimney) is led to each retort by a pipe D placed either centrally between the retorts or alongside thereof. The passage of steam through this pipe (regulated by a valve E) is connected to each retort by means of branch-pipes F provided with cocks G. The steam valves may be actuated by a chain

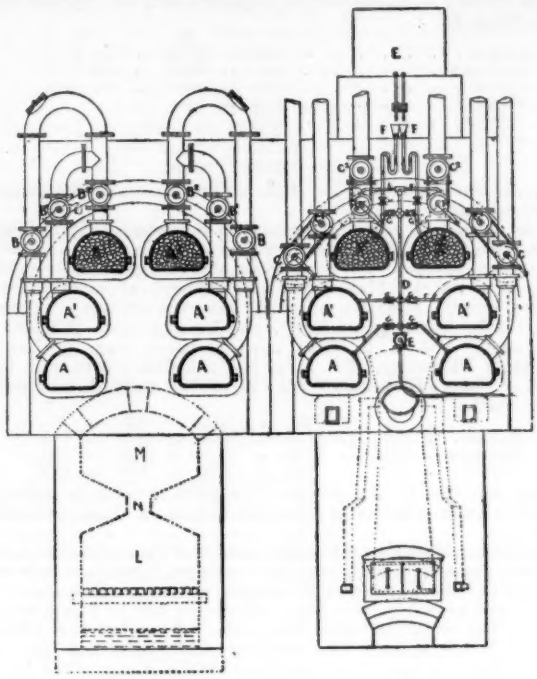


Fig 1 Fig 2

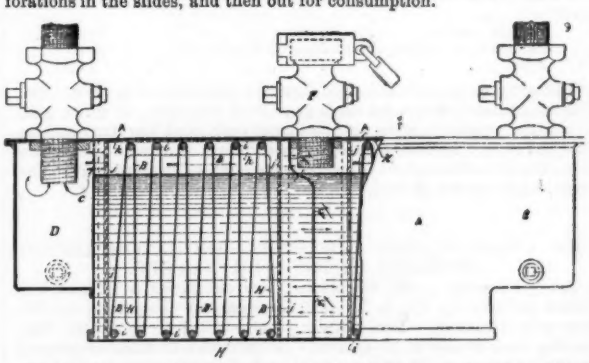
passing around wheels on the spindle of the regulating valve H, and around wheels on the spindles of the gas-regulating valves, so that the reversal of the latter simultaneously effects the reversal of the steam-valve. The steam enters any one of the retorts—flowing to the back end and returning to the front—and then through a second retort. In its passage through both retorts the steam being more or less completely decomposed according to the reaction: $2\,H_2O + 2\,C = 4\,H + 2\,CO$.

When the coal or cannel is charged into any one of the retorts, this retort should be connected (by the opening of the valves in the manner already described) with one of the other retorts, the material in which is in a state of incandescence, and in passing through which the volatile hydrocarbons are freed from, or deposit their tar or suspended liquid or solid hydrocarbon. The tar left behind in the retort is decomposed during its passage (and in contact with the steam, resulting in a mutual decomposition); the resultant gases flowing to the holder along with the water gas. The gas is enriched by injecting into the incandescent fuel in the retorts tar, naphthalene, or any other liquid hydrocarbon.

In fig. 2, E represents the oil tank; and in this application the oil flows into funnels F, and from them falls (or is injected) into the retort by pipes and a steam-jet G connected to the main steam supply-pipe by connections and valves H. In order to prevent the oil pipes from being choked with deposited tar, a constant flow of steam is maintained through them. The arrangement of bafflers H, formed (as shown) of refractory material, is intended to partially superheat the steam and volatilize the oil that may be injected into the retorts.

CARBURETTING GAS.—Hall, J. D., of Liverpool. No. 387; Jan. 9, 1889. [8d.]

This invention relates to apparatus for increasing the illuminating power of coal gas by passing it through vertical perforated copper slides interlined by woollen fabric, which draws gasoline to the top of the machine where it mixes with the coal gas and passes through the perforations in the slides, and then out for consumption.



Within the case of the apparatus A is fitted textile material B. The end plates C are provided with apertures or perforations at the upper part, as shown; and there is a central division plate or diaphragm perforated from top to bottom. D and E are the entrance and the exit chambers respectively, in which the condensed oil collects. They are provided with screw plugs by which the liquors may be drawn off. There are also cocks for controlling the ingress and egress of the fluid to be carburetted to and from the apparatus. F is a cock through which the apparatus is charged with the hydrocarbon liquid. H are the frames which support the material B. Each pair is connected by rods I, over which the material is passed in a continuous strip as shown; and they

are fixed in the case between guide bars J. One pair of frames and bars are provided on each side of the central diaphragm. The roof and sides of the apparatus are lined internally with a layer of the textile material K; and the upper rods I are so arranged that the material which passes over them touches that on the roof. Also the material is "fulled" laterally on the rods—that is, the width of the material is greater than the length of the bars between the frames H—so that at the sides it lies against the material which lines the side plates of the apparatus. Hence no gas can pass through the apparatus without coming into contact with the textile material; and this being all charged with hydrocarbon, the gas in passing through the carburetter, necessarily at all points comes into contact with the hydrocarbon, with the result that equal carburetting effect is obtained, and a "homogeneously carburetted gas" is produced.

INCANDESCENT GAS-BURNERS.—Pitt, S.; communicated from C. B. Harris, of New York. No. 14,090; Sept. 6, 1889. [8d.]

This invention relates to the combination with a number of groups of suspended filaments or pencils (of the Fahnejelm type), arranged at angles to each other, so as to form a triangular or polygonal figure, of a corresponding number of gas jets or burners above which they are suspended; the object of the invention being to provide an incandescent burner, which will not cast lateral shadows, and which will direct or diffuse the light practically equally in all directions. The invention further consists in certain improvements in the manner of suspending and adjusting the filament-holders.

Alluding to his invention, the patentee says: As is well understood, burners of the class described, are to be used with hydrogen gas or water gas having little (if any) alluminant. The pencils or filaments employed may be of the ordinary kind—such, for instance, as magnesia—mixed in their preparation with a small portion of starch. The pencils are to be held by their upper ends in the holders by means of packing of the same material applied while in a soft or plastic condition. By preference, the filaments are so grouped in side view as to present a curved line at their lower ends, in order to conform somewhat to the shape of the flame of an ordinary gas-jet.

MANUFACTURING HEATING GAS.—Kitson, A., of Philadelphia, U.S.A. No. 14,922; Sept. 21, 1889. [8d.]

This invention relates to a gas generating furnace adapted more particularly for manufacuring non-luminous heating gas continuously by the injection of steam, air, and oil into a body of incandescent fuel; the air serving to promote combustion, while the steam is decomposed and converted into hydrogen and carbonic oxide. The generator is provided with two fuel chambers and a connecting base chamber, having arranged in it suitable steam superheating coils and air heating pipes, in the path of the hot gas which flows from one fuel chamber to the other. It is also proposed to extend the steam and air pipes up through the division wall separating the fuel chambers, and connect them with the injectors—one opening into the top of each fuel chamber; also a chimney pipe and a gas take-off pipe are connected with the top of each fuel chamber.

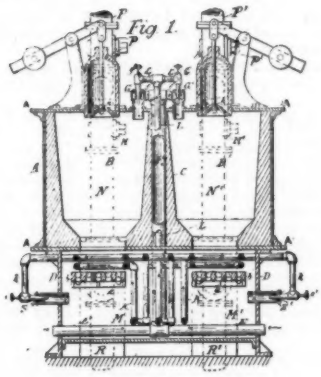


Fig. 1.

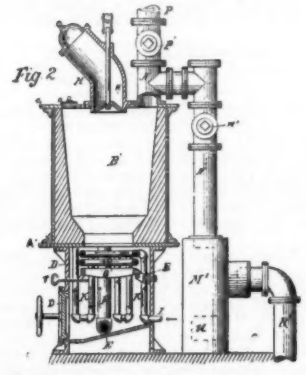


Fig 2

Fig. 1 is a vertical longitudinal section through the apparatus, showing both fuel chambers. Fig. 2 is a transverse section at right angles to fig. 1.

The iron shell A is lined with fire-brick or other refractory material, and divided by the central vertical transverse partition C, into two fuel chambers B B^1. These chambers are mounted upon the base D, which forms a chamber connecting their lower ends and serves as an ash-pit. The grates are preferably mounted about 3 inches below the bottoms of the chambers B B^1, so that coils may be arranged between them. The grates are supported at their rear edges upon brackets bolted to the rear wall of the base D, and at their front edges upon removable pins, which may be withdrawn for letting down the grates when it is desired to remove the cinder and ashes. A fuel supply hopper H, having a bottom valve with a connected weighted lever, is fitted to the top of each fuel chamber. Air inlet pipes E, project slightly through the walls of the base D, and connect with a vertical pipe F, which passes through the division wall C, and at the top connects by branch pipes with injectors G G^1, which open downward into the chambers B B^1. One or more supply pipes I, for steam or water, pass through the wall of the chamber D, and connect with the coils K, arranged in the middle portion of the base D. The horizontal coils arranged between the outer edges of the grates and the lower ends of the fuel chambers, connect with coils K, and are provided with branches extending through the the walls to injectors S S^1. A pipe L extends from the coil K up through the wall C, and connects by branches with injectors G G^1. Gas take-off pipes N N^1 lead from the tops of the chambers B B^1, and extend in the hydraulic seal boxes M M^1, as shown in fig. 2. Pipes R R^1 conduct gas to the purifier or place of immediate use. Chimney pipes P P^1 (having valves) rise from the pipes N N^1, and are used for the escape of smoke when required.

The generator is operated as follows:—The chimney valves and ash-pit doors being open, fires are kindled on the grates, and coal gradually fed in till well ignited by natural draft. Water is admitted to the coil by the pipe I, and is quickly converted into steam by circulation in the coils above the grates. As soon as steam, at the desired pressure, is formed, the doors are closed, and steam is admitted to the injectors S S^1, by which blasts of air and steam are driven into the fuel and the generation of gas commenced. When gas of the desired quality is generated, the chimney valves are closed, and the valves in the gas take-off pipes opened. When bodies of fuel of sufficient depth are well ignited the valves of the injector S S^1 are closed, and the valve of the injector G^1 is opened. A current of highly heated steam and air is thus admitted into the top of the chamber B^1. They pass into the body of highly heated fuel, where decomposition is effected; and the resulting hot gas passes down into the base chamber D, in contact with the steam and air pipes, imparting to them a high heat, and then pass up into the body of fuel in the chamber B, where any carbonic acid which may be present is converted into carbonic oxide, and a fixed high-grade heating gas produced, which escapes from the top of the chamber B and passes by the take-off pipe N to the seal box, from which it is conducted to the scrubber, holder, or place of immediate use. After a suitable time, as will be indicated by the condition of the fires, the direction of the blast of air and steam (and of the course of the gas) is reversed; and when gas is generated as before, it is taken off from the top of the chamber B^1 instead of the chamber B.

APPLICATIONS FOR LETTERS PATENT.

19,868.—LANCHESTER, F. W., "Improvements in gas motor engines." Dec. 10.

19,875.—NEWMAN, N., "Improvements in electric gas lighters and extinguishers." Dec. 10.

19,958.—FOX, F. W., "Improvements applicable to boiler and other fires, gas-stoves, and the like, for consuming the smoke of offensive vapours." Dec. 11.

20,008.—DUGDALE, E., "Improvement connected with gas-burners." Dec. 12.

20,031.—SMITH, W., "Improvements in lighting by means of gas." Dec. 12.

20,083.—SIEMENS, F., "Improvements in regenerative gas-furnaces and gas-producers." Dec. 13.

20,115.—FORD, S., "Improvements in rotary gas-engines." Dec. 13.

20,144.—RIGBY, T. P., "Improvements in or appertaining to gas-burners and arrangements for lighting the same." Dec. 14.

20,161.—DUERR, F., "Improvements in gas-motors." Dec. 14.

20,174.—ROBINS, J. J., and SHAKESPEARE, W., "An improved self-sealing door for gas-retorts or other purposes." Dec. 16.

20,194.—DANKS, A. T., "Improved contrivances for showing in a single line the register of dials on gas and other meters." Dec. 16.

20,249.—CRIST, W. E., and COVERT, H. C., "Improvements in gas-engines and igniters for the same." Dec. 17.

20,255.—BROWN, T. S., and BROWN, A. W., "Increasing the illuminating power of gas, called the 'Acme gas saver.'" Dec. 17.

20,276.—WILSON, G., "Improvements in gas-stoves." Dec. 17.

20,360.—STOCKMAN, H., "Improvements in burners." Dec. 18.

20,366.—WELLWORK, R., and WELLS, A. C., "Improvements in or applicable to self-generating gas or vapour burners." Dec. 18.

20,375.—KITT, A., "An improved mode of and apparatus for transferring coal and other materials from colliers or other vessels to land." Dec. 18.

20,396.—CRASTIN, C., "Improvements in and relating to lamps or lanterns." Dec. 18.

20,414.—HARGREAVES, J., "Improvements in hydrocarbon illuminating lamps." Dec. 19.

20,432.—GRAY, T. H., and BROMHEAD, S. S., "Improvements in the preparation of coal gas for combustion and in apparatus for the same." Dec. 19.

20,474.—VERNON, F. W. B., "An improved gas-stove." Dec. 20.

20,505.—PATTERSON, E., and M'FARLANE, J., "Improvements in regenerative gas-burners." Dec. 20.

20,551.—WEST, J., "Improvements in machinery for charging gas-retorts." Dec. 21.

20,583.—BROWNHILL, R. W., "Improvements in, or additions to, gas and liquid meters in exchange for coin or equivalent." Dec. 21.

ACCRINGTON GAS AND WATER OFFICIALS' CHRISTMAS GATHERING.—The officials of the Accrington Gas and Water Company had their annual Christmas dinner on Wednesday, the 18th inst., at the Railway Hotel, Accrington. Mr. C. Harrison, the Company's Secretary and Manager, occupied the chair; Mr. Dean, the General Outdoor Superintendent, taking the vice-chair. Among the toasts proposed after that of "The Queen" was "Our Chairman and Board of Directors," which was cordially received. The proceedings throughout were of a very entertaining and enjoyable character.

Correspondence.

[We are not responsible for the opinions expressed by Correspondents.]

THE DINSMORE PROCESS.

SIR,—I note that Mr. Valon, in his letter of last week, makes no admission of the fallacy of his specific gravity calculations, to which I drew attention in my letter of the 17th inst.

In reply to Mr. Martin, the figures in my balance-sheet are perfectly correct. The statement in my paper which Mr. Martin is unable to reconcile with the figures he instances in the balance-sheet, ought to be understood to be a general one. But whether the quantity of coals carbonized on the Dinsmore process should prove at the end of the year to be either a few hundred tons more or less than the actual figure given, it will make very little difference to the sum-total of the profits accruing from the Dinsmore process.

I note that Mr. Martin, like Mr. Valon, goes into the specific gravity question; and it appears to me that his (Mr. Martin's) figures are also based upon "generally accepted data," rather than upon actual experience. As it is probable that the class of coal used at the Ormskirk Gas-Works will be somewhat similar to that used at Widnes, the actual specific gravity and illuminating power of the Ormskirk gas would be of interest.

With regard to the life of the "duct," this will last much longer than an ordinary retort, as it does not have to sustain the wear and tear of drawing and charging. Further, the temperature being lower than that of an ordinary retort, the deterioration in this respect is not so great.

No debit charge is necessary on account of the water used for cooling the outlet pipes of the duct; for the whole of the water is afterwards utilized in the works.

ISAAC CARR.

Widnes, Dec. 28, 1889.

CAMBORNE GAS COMPANY, LIMITED.—A Company under this title has lately been registered with a capital of £10,000, in £5 shares, to manufacture, sell, and supply gas, electricity, or any other illuminating agent in the town of Camborne (and elsewhere within a radius of four miles from the present boundary of the township), for lighting, warming, heating, and cooking purposes, and the supply of motive power within that district; and to carry on the general business of a gas and lighting Company.

ACCIDENT AT THE OLDBURY GAS-WORKS.—A mishap of an unpleasant character occurred at Oldbury Corporation Gas-Works last Wednesday week. It appears that the works were erected on land where two or three pits were formerly worked; and it is believed that the locality has been honeycombed by colliery workings. It is stated that the authorities were under the impression that the shafts had been filled up; and consequently no fear was entertained of any subsidence. A large quantity of coal is stacked in the yard attached to the works; and a portion of it happened to be placed over one of these old shafts. On the day mentioned, the ground suddenly gave way; and about three or four boat-loads of coal—variously estimated at from 75 to 100 tons—disappeared below the surface, having, it is supposed, fallen down one of the pit-shafts, the covering of which had given way by reason of the subsidence.

THE LIGHTING OF COURTS.—In last week's JOURNAL, reference was made to the question of the lighting of the courts of Manchester and Birmingham. At the last-named place, it is acknowledged that the courts ought to be lighted; but the City Council cannot determine who should bear the cost of carrying out this much-needed improvement—the ratepayers or the owners of property in the courts. On this point, the Liverpool Town Clerk informs a Birmingham contemporary that "the private streets and courts in the city, together with such passages as are reported upon as requiring to be lighted for police purposes, are lighted at the public cost, and the gas-lamps, posts, &c., have been provided at the like expense under the provisions of the Public Health Act, 1875. The Council have not obtained any special powers in the matter. Courts and alleys are cleansed by the Corporation under the provisions of a local statute." The courts and alleys of Bolton are also both cleansed and lighted at the public expense.

ADVANCES IN THE PRICE OF GAS.—At a recent meeting of the Gas Committee of the Darwen Corporation, it was decided to increase the price of gas 6d. per 1000 cubic feet. It was stated that the increase is in consequence of the recent advances in the price of coal and concession of the demands of the stokers. An alternative proposal to increase the price only 4d. was withdrawn on Alderman Lightbown explaining that this would not cover the deficit. The price for street-lamps is also to be advanced from £2 5s. 2d. to £2 10s. for every lamp burning 2200 hours per annum. A special meeting of the Council has been called to consider the matter. The Oldham Corporation Gas Committee have decided to advance the price of gas 2d. per 1000 feet from the 24th inst. In this case also the increase is stated to be due to the enhanced price of coal and the additional wages paid to the men. On the same grounds, the Stockport Corporation Gas Committee have resolved to raise the price 1d. per 1000 cubic feet; making it 2s. 6d. The Gas Committee of the Bolton Corporation decided on Friday last to advance the price of gas 2d. per 1000 cubic feet.

THE ST. PANCRAS VESTRY AND ELECTRIC LIGHTING.—Having long had in contemplation a project for the electric lighting of the parish, the St. Pancras Vestry are about to put it into execution. From a report prepared by Mr. T. Eccleston Gibb, the Vestry Clerk, it appears that the Vestry are of opinion that they will make a good thing of it for the ratepayers, besides supplying the public at very moderate rates. They are permitted to make a profit of 7 per cent. per annum by electric lighting, and apply this sum to relieve the rates in any way they think proper. On the assumption that the first installation would be for 10,000 lights, Professor Robinson has calculated that the total expenditure would be £50,000, and the profit £3500 per annum. If this sum were applied to pay for public lighting by arc lamps, it would be sufficient to cover the working expenses for 90 lamps. The £3500 would have to be made out of the profits on the sale of 800,000 units per annum, to private consumers, or 1·05d. per unit. The cost price per unit with condensing engines in an installation of this size will be 3·30d. Adding 1·05d. to pay for public lighting, makes the price 4·35d. per unit supplied to private consumers—say, 4¼d. per unit. This would be considerably less than the price charged by the companies. It therefore appears that the Vestry could supply private consumers at 4¼d. per unit, and pay the working expenses of 90 arc lamps, which would replace about 400 ordinary gas-lamps, now costing £1120 per annum. The rates would, of course, be reduced by this amount. It is claimed that future extensions of the lighting would be attended with a similar reduction, which might be taken at 2 per cent. on the amount of the capital expended.

Legal Intelligence.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

(*Before Justices* DENMAN *and* MATHEW.)

NIXON'S NAVIGATION COMPANY, LIMITED *v.* MOUNTAIN ASH LOCAL BOARD.

This was an appeal from a decision of Mr. Justice Field, in chambers, refusing to refer the action to one of the Masters of the Supreme Court to decide the question of liability, and what amount of costs should be paid by the defendants. It appeared that the plaintiffs some years ago supplied the district of Mountain Ash, Glamorganshire, with gas and water. The Local Board, however, coming to the conclusion that it was to the interest of the district that they should take into their own hands the supply of water and gas, promoted a Bill in Parliament to enable them to acquire the plaintiff's works. At first the Navigation Company opposed the Bill; but ultimately an agreement was come to under which the Company gave their consent to it upon conditions which were introduced into a schedule to the Act of Parliament. One of these conditions was that the Board should pay all the costs incurred by the plaintiffs, whether as to arbitration or otherwise. The agreements were made in the year 1886; and when the plaintiffs sent in their bill for costs, it amounted to above £3000—£175 being for parliamentary expenses, and the remainder the solicitors' bills of costs.

Mr. GAINSFORD BRUCE, Q.C., and Mr. CHITTY appeared for the plaintiffs; Mr. VAUGHAN WILLIAMS, Q.C., and Mr. BANKES, for the defendants.

Mr. VAUGHAN WILLIAMS argued that the matter ought to be referred to a Master to tax the costs, as they were extravagant.

Mr. BRUCE contended that the Master was not a proper person to refer the matter to, as it was not a question of the taxation of costs at all. It was a claim under an agreement. The costs had been paid by the plaintiffs a year ago; and all they wanted was to recover the money which they had paid out of pocket under the agreement.

Justice DENMAN said he concurred with Mr. Justice Field in holding that a Master was not the proper tribunal to refer this case to, as it was not an ordinary question of taxation.

Justice MATHEW was of a different opinion, but deferred to Justice Denman as the senior Judge.

The appeal was therefore dismissed with costs.

BOW STREET POLICE COURT.—SATURDAY, DEC. 28.

(*Before Mr.* BRIDGE.)

CHARGE OF INCITING TO MURDER MR. G. LIVESEY.

Henry George Wier, described as a compositor, was charged on a warrant for "that he did, on the 22nd of December, 1889, at a meeting of divers persons assembled in Hyde Park, unlawfully incite, encourage, persuade, and propose the murder of a certain person—to wit, one George Livesey."

On the prisoner being placed in the dock,

Mr. BESLEY asked to be allowed to say he was instructed by Messrs. Shaen and Roscoe, Solicitors to the London Society of Compositors—one of the oldest and best-known Trades Unions in England—to attend on their behalf. The Society were most anxious that it should be stated at the earliest possible moment that they were not represented in any way whatever at the meeting in Hyde Park on the previous Sunday, and that any opinions expressed by Mr. Wier were his own individual views. The reason the Society desired to appear by Counsel was to prevent an erroneous impression being created that they had taken part in the dispute between the gas stokers and the South Metropolitan Gas Company.

Detective-Inspector *Greet* proved the arrest of the prisoner at 3, Racquet Court, Fleet Street (the rooms of the Society of Compositors) on the preceding day; and stated that he only wished to give sufficient evidence to enable him to ask for a remand.

When the warrant was read over to the prisoner on his arrest, he said, "That is not true;" and he then made a statement which was taken down in writing.

The information of Police-constable *George Lambert* was then read over as follows:—"I was on duty in plain clothes in Hyde Park on Sunday, the 22nd of December, 1889, when a meeting was held of the gas stokers. There were about 3000 or 4000 persons present; and the meeting was addressed from several platforms. I was near to No. 4 platform, of which a Mr. M'Carthy was the chairman. There were several speakers, and among others was a Mr. Weir, who used the following words in the course of his speech:—"Fellow-workmen, I can tell you that the 8000 men whom I represent—that is, the Compositors' Union—are prepared to stand by you to the utmost. I am unable to support you much myself, but I can assure you my heart is with you. Mr. Livesey says he has got £40,000. Remember that he got it out of you workmen. It is a disgrace that he should be allowed to use it against you. I say he has no right to live; and I say that the man would be a hero who went to-night and murdered him.'"

Mr. BRIDGE (to the prisoner): I propose to remand you till next Thursday. Do you wish your statement to be read? If so, I will allow it.

Prisoner: Not to-day, Sir. I have been a member of the Compositors' Society 15 years. My father is here, and will become bail for me if you will take bail.

Mr. BRIDGE said he could not do so.

Prisoner was then removed in custody.

LAMBETH POLICE COURT.—MONDAY, DEC. 23.

(*Before Mr.* PARTRIDGE.)

INCIDENTS OF THE SOUTH METROPOLITAN GAS STRIKE.

To-day *Alfred Norgrove*, 40, described as a labourer, one of the new hands engaged by the South Metropolitan Gas Company, to replace the men on strike, was charged with feloniously shooting Francis Chambers, aged 28, with intent to murder him, at Leopold Street, Vauxhall.

Mr. INMAN (Messrs. Wontner & Co.) defended the accused, on behalf of the Company.

A witness named *Fricketts*, an engineer's labourer, stated that on the night of Sunday, the 22nd inst., he was in the Lord Clyde public-house at Vauxhall; the injured man being with him. At closing time they left the house, and shortly afterwards witness heard the report of firearms, and Chambers called out, "I am shot, George." Witness then saw the prisoner a few yards off, moving away. Witness followed, seized hold of him, and both fell to the ground. The prisoner had a pistol in his hand. He held prisoner until several persons came up, and then handed him over to a constable. Chambers was removed to the hospital.

George Barratt said he was employed at the Vauxhall Gas-Works. He was in the Lord Clyde with others on the night in question. The prisoner was also there, and entered into conversation. The prisoner promised to give information to the Secretary of the Gas Workers' Union as to how the men at the gas-works were being treated. The prosecutor was in the house, but did not join in the conversation. Witness saw the prisoner put his hand in his outside coat-pocket, and take out something. Witness called out, "Stand on one side; he has drawn either a revolver

or a pistol." The prisoner went out, and witness and prosecutor followed. Witness saw a constable close by, and called out, "Stop him (the prisoner); he's got either a knife or a pistol." The constable went up to where prisoner was, and just then the pistol was discharged. The prosecutor called out, "I have got it in my side," and then fell into the arms of witness. At the time of the report of the pistol, prisoner was getting up from the ground, and he then held the revolver in his hand.

Mr. *Halbert*, house surgeon at St. Thomas's Hospital, said the prosecutor was in the hospital suffering from a wound in the side; but he was not in danger.

Inspector *Paget* said the revolver was brought to the station. He found four chambers still loaded, and two recently fired. He told prisoner the charge, and he said: "I had no intention of shooting anyone."

In answer to Mr. INMAN, witness said prisoner's mouth was bleeding, and his face was bruised. He said he had been knocked about by the stokers.

After some further evidence, the cross-examination of the witness was reserved; the prisoner being remanded in custody.

SATURDAY, DEC. 28.

To-day the accused was again brought up, and committed for trial.

A woman appeared before his Worship, and stated that George Oliver, her husband, had disappeared. A short time back he came to London, and on the previous Tuesday was engaged at the South Metropolitan Gas Works, in the Old Kent Road. He had not since been seen or heard of. The officials were not aware whether he had left the works or not. Mr. Partridge asked if the police had been communicated with; and was informed that they had a description of the missing man but still he had not been traced. His Worship was informed that the Company had undertaken to allow the woman £1 a week for the present.

GREENWICH POLICE COURT.—MONDAY, DEC. 23.
(*Before Mr.* KENNEDY.)

CONVICTION OF A STOKER FOR ASSAULT AND DAMAGE TO PROPERTY.

William Perry, 49, a gas stoker, was charged with wilfully damaging a shirt and pair of socks, value 3s., the property of Henry Williams, another stoker, whom he was further charged with assaulting. Williams was one of the new hands taken on by the South Metropolitan Gas Company.

Mr. PASSMORE appeared for the prosecution; and Mr. SCARD for the defence.

Mr. PASSMORE said the Company were bound to protect the new hands who had taken the places of the men on strike, and he must ask the Magistrate to punish the prisoner in such a manner as to act as a deterrent to others.

Complainant said he went into the Dover Castle public-house, near the West Greenwich works of the Company, where he was employed as one of the new hands. He had a shirt and a pair of socks in a bundle, and 6s. in money. The prisoner asked him in the public-house whether he worked at the gas-works. Witness was afraid, and said he did not; but the prisoner said, "Yes, you do." Witness went out, and the prisoner followed him into the passage, where he struck him a violent blow in the eye, and knocked him down. He lost his bundle, which was forced out of his hand.

George Bloombridge, another new hand, from Tunbridge Wells, said he saw the prisoner assault the prosecutor. He also knocked witness against the wall.

Police-constable *Batty* said he arrested the prisoner in another beer-house, when he said, "You've made a mistake this time. I have never seen the man before."

For the defence, two witnesses declared that the prisoner committed no assault whatever, and they heard no question asked as to whether prosecutor was employed at the gas-works.

Prisoner was fined 20s. and 5s. damage, or 14 days' imprisonment.

THURSDAY, DEC. 26.
(*Before Mr.* FENWICK.)

COMMITTAL OF GAS WORKMEN FOR ASSAULTING THE POLICE.

To-day four gas workmen, named *Thomas Brown*, *James Jarvis*, *George Minter*, and *Samuel Parker*, who had been apprehended on warrants, were charged with assaulting the police in the execution of their duty on Greenwich Marshes during the disturbance caused by the turning out of the men employed at the South Metropolitan Gas Company's works.

Mr. PASSMORE prosecuted on behalf of the Company; Mr. SCARD defended.

The evidence showed that on the previous Saturday a body of police were escorting a number of new gas workmen from the Westcombe Park Station, East Greenwich, and were followed by a mob of between 150 and 200 men and boys. In Marsh Lane the men threw stones at the police, several of whom were injured. The prisoners were proved to have been in the mob, and to have taken part in the attack. In the case of Parker, Inspector Hocking said he was taken into custody, but was rescued by the mob. One sergeant was severely injured, and was suffering from concussion of the brain.

Mr. FENWICK sentenced Parker, Minter, and Jarvis to one month's, and Brown to two months' hard labour.

On the sentences being passed, great astonishment was manifested by the prisoners and their friends in Court; and a clergyman addressed the Magistrate on behalf of Parker, who, he said, was a respectable young man and a member of his church. Mr. Fenwick, however, said his decision must stand.

THE ACTION AGAINST MR. ELLIS LEVER.—The case of the *Salford Corporation v. Ellis Lever* recently came before one of the Masters in Chambers at the High Court of Justice. The defendant asked for an order (1) to compel the Corporation to furnish him with copies of the reports presented by Samuel Hunter to the Gas Committee; (2) with the date of an alleged agreement between Hunter and Lever as to the payment of commissions to Hunter on coal supplied to the Salford Corporation by Lever, and the payments mentioned therein; (3) particulars of the various payments alleged to have been made by Lever to Hunter, with dates and particulars of the market price of coal at the time, and the excess of the contract price over such market price; (4) particulars of the agreements to pay the bribes alleged to have been paid, with dates and amounts of all such payments; and (5) particulars of the portion of the commission alleged to be still in Lever's hands. The Master, after hearing Counsel on both sides, ordered, as to the first matter, that the Corporation should furnish particulars of the reports made by Hunter to the Gas Committee; and, as to the second matter, that it should stand over until defendant's answer had been given to the interrogatories, and then that the order should be curtailed by the omission of the words "particulars of the amounts and dates and the payments therein mentioned." As to paragraphs 3, 4, and 5, the Master refused to make any order.

Miscellaneous News.

GAS WORKMEN AND THE LABOUR QUESTION.

THE SOUTH METROPOLITAN COMPANY AND THEIR DIFFICULTIES.

Our chronicle of the progress of the dispute between the South Metropolitan Gas Company and their workmen closed last week with the reproduction of the letter addressed to Mr. George Livesey, on Friday, the 20th inst., by Messrs. Hutchins and Davis, on behalf of the Strike Committee, embodying the latest proposals of the men for a reconciliation. To this letter the Secretary of the Company (Mr. Frank Bush) replied on the following day to the effect that it should be laid before the Board at their next meeting, and a reply sent as soon as possible. A leading member of the Committee stated, in answer to inquiries, that Mr. Livesey seemed anxious to remain on good terms with the old men, and shook hands most cordially with the members of the last deputation which waited upon him; and a strong belief seemed to prevail that the difficulties in the way of a compromise did not rest with him personally to so great an extent as had been supposed. With the view of assisting in bringing about an amicable settlement of the dispute, a deputation of the Executive Committee of the Labour Association (an institution for promoting co-operative production based on the co-partnership of the workers) had an interview, by appointment, with Mr. Livesey in the afternoon. The deputation consisted of the President of the Association (Mr. A. K. Connell), the Honorary Treasurer (Mr. E. O. Greening), and the Secretary (Mr. H. E. Ivimey); and Mr. Livesey was accompanied by Mr. White (a Director) and the Secretary. Mr. Greening explained that the Labour Association, having at heart the promotion of profit-sharing as a means to industrial peace, was naturally anxious that the trial of the principle by a great Corporation like the South Metropolitan Gas Company should to made under favourable conditions. If they could assist to remove he difficulty between the Company and its *employés*, they would be glad. Mr. Livesey, in reply, said that he had never threatened to break up the Union, or had any such intention. Beyond a casual expression of his, which had been quite misunderstood, nothing he had ever said could even remotely be supposed to warrant the suspicions so widely circulated. He offered the deputation distinct proof of the sincerity of his intentions by producing the draft of his original profit-sharing proposals to his Board, and reading to the deputation the reasons wich prefaced them. Urged by them to make this document public, he and his colleagues agreed to bring their request before the Board. He repeated emphatically that the details of the "agreement" were unimportant. The Company had modified them, and were willing to further modify them. The Company were contending only for the principle of being permitted to establish such friendly and reasonable relations with their *employés* as would remove the danger of frequent strikes. Mr. White corroborated Mr. Livesey's declarations; adding that the Board were unanimous. Looking at the emphatic disclaimers by the Company of any covert design against the rights of combination amongst their men, and after considering the results of their interview, the Executive of the Association hoped that a way out of the difficulty might be found; and he expressed the desire to continue their efforts to this end. The prospect of the success of this movement in the direction of peace was not brightened by the subsequent conduct of the men. At night, in spite of inclement weather, there was a demonstration at Rotherhithe, at which, as well as along the route taken by the procession, collections were made for the strike fund. The meeting was attended by a large number of gas stokers, coal porters, and the general public. Mr. Candy presided, and said the men were fully determined to stand out against Mr. Livesey and the bonus system, and would not on any account work with "blacklegs." He maintained that the gas workers had been most cruelly treated; and it was with great pleasure that he saw the public supporting them. If the Company were in any way inclined to act in a fair manner, they should, without any further delay, give in peaceably to a settlement. The gas stokers were just as resolute as was Mr. Livesey, and meant to stand out until they had won their battle and saved their Union from destruction. A resolution calling upon the Company to withdraw the bonus system and allow the men to resume work was carried. The Strike Committees at all the centres were engaged all day distributing strike pay. It had been hoped that the men would have been paid 20s. each; but the Committees stated that, as they had about 2200 strike hands on their books to be provided for, they had only been able to pay 10s. each. The pickets had now all been withdrawn, and the new hands were no longer confined to the works. The production of gas at all the stations was steadily maintained, though the quantity in store had not been increased, owing to the demands of the consumers. It may be mentioned here that one of the strikers, named Hester, was sentenced at the Southwark Police Court, the previous Thursday, to a month's imprisonment, with hard labour, for assaulting one of the new hands.

On Sunday, the 22nd, a mass indignation meeting was held in Hyde Park at midday, at which about 3000 men were present. There were six platforms, from which addresses were delivered by representatives of the Gas Workers' Union, the Coal Porters' Union, the National Amalgamated Sailors' and Firemen's Union, the Dockers' Union, the South Side Labour League, and the London Liberal and Radical Clubs. At the Gas Workers' platform, Mr. Hutchins presided; and in the course of his address said the meeting represented not only the gas stokers but several other trades. Every week Mr. Livesey's coal supply would become shorter; and there it would remain until he came to face the stokers and coal porters in a proper manner. If the men would only keep calm and cool, they would win one of the greatest victories ever achieved; but if they did not stick together, then woe to labour in the future. This grave quarrel did not threaten the existence of one Union alone, but every other Trade Union in the Kingdom; and the fight would have to be won at any cost. In conclusion, he said that the present position was that the bonus agreement would have to be withdrawn; and that the question as to how the bonus should be given—if Mr. Livesey really meant to give it—should be left to be settled jointly between employer and employed. At the Coal Porters' platform, Mr. Cooper presided; and he stated that all coal porters were forbidden to load or unload coals consigned to the South Metropolitan Gas Company. About 250 members of the Union had left their work at the gas factory; and all the others would do so if necessary. They were all determined to fight out the battle to the bitter end; and therefore the sooner Mr. Livesey gave in, the better it would be for his shareholders' money. At the Sailors' and Firemen's meeting, speakers urged all seamen to join the Union, and not work ships going to the Company. A resolution was put to the meeting to the effect—"That this meeting of gas workers, coal porters, and others deplores the action of the South Metropolitan Gas Company; and, whilst protesting against Mr. Livesey's attempt to crush the Gas Workers' Union, demands the withdrawal of the bonus agreement." This was carried with cheers, and the meeting dispersed. This meeting must not be passed over without reference to an important incident which marked it, but upon which most of the newspapers were judiciously silent. Among the various speakers was

Mr. Ben. Tillet, whose name was conspicuous during the dock labourers' strike; and, according to the report of the proceedings given by the representative of *The Times*, this gentleman was succeeded by a man who stated that his name was Wier. "Having," said our contemporary's reporter, "said of Mr. Livesey that 'he ought not to live 24 hours'—that 'he ought to be got rid of'—Mr. Wier proceeded in the following terms:—'I say a man like Livesey has no moral right to live in this country, and the man would be a hero who went to-night and murdered him.' Again, he said that the man who should so act would be 'a hero, and one whom we ought to worship.' He proceeded: 'There is not much of me; but what there is I am willing to sacrifice to the cause of my fellows.' These sentiments were loudly applauded. The utterance was the most violent that I have heard during the course of the recent labour disputes. The words were used to men who know very well that they have been defeated, and were pointed at the man who has beaten them." The writer then referred to a rumour which had been current that the word had been "passed round" among the gas workers on the north of the Thames to the effect that, unless those on the south obtained their demands, the workers on the north would be called upon by the Union to strike work during Christmas week.

The rumours above referred to, taken in conjunction with the violent language used at the Hyde Park meeting on the 22nd inst., and the combined action of the Coal Porters' and Seamen's Union to stop the supply of coals to the Company, were the disquieting events of the following day. The utterances of Mr. Weir (who was stated to be a compositor, and, of course, unconnected with the parties to the dispute, except perhaps as having a common interest with them in a great labour movement) had been brought to the notice of the proper authorities, who considered the advisability of instituting a prosecution of him on the public behalf.* In this connection we have to record the receipt by Mr. George Livesey, through the post, of a threatening letter from some illiterate person, to the effect that as he would not give in, and the writer's family were starving for bread, he had better beware of dynamite, as his place would be blown up before Christmas. This communication was made the subject of investigation by detectives. It was believed that the writer would be traced; as, in penning the document, he had carelessly given an important clue to his identity. Mr. Livesey did not seem to entertain any fear whatever as to his personal safety; but extra precautions were taken to guard the Company's premises. There was an abundant supply of gas at all the stations. With regard to the position of the men generally, the fresh hands were gradually becoming more expert in their duties; while several of the old hands had been allowed to return to work on giving an assurance that they would co-operate amicably with the new men who had been engaged in the emergency. As to the application of the men's representatives for the withdrawal of the first three clauses of the profit-sharing agreement referred to last week (p. 1208), the Directors could not accede to the request. Such a modification of the agreement, would, it was thought, only be to the disadvantage of the men themselves, and tend to hamper the Company in their efforts to promote thrift and good service. The strikers repudiated the action of the officials of the Labour Association who had the interview with Mr. Livesey on the 21st; and said they relied on the stoppage of the coal for winning their battle.

On Tuesday the following letter was sent by Mr. G. Livesey to Mr. Hutchins, in reply to the one received from him and Mr. Davis (on behalf of the Strike Committee) at the close of the previous week:—

"Sir,—Your letter received on Saturday has been considered by the Board to-day, in which there are two main points to be answered. In the first place, your objection has been all through, and is still, to the profit-sharing arrangement itself, rather than to mere details; for you say, in the face of our repeated statements to the contrary, that 'We are of opinion that the bonus scheme in question, however much its detail may be subject to revision, was formulated purely in order to break the Union;' and that 'it was nothing but a seductive, though most plausible bribe, to throw dust into the eyes of the men.'

"The reply to be given to these assertions is to state exactly how the scheme originated. On the 20th of September the entire body of stokers gave their week's notice to leave their work, after they had been assured that the matter complained of would be redressed. Their subsequent conduct showed that they were ready, on the slightest pretext, to do so again at any time. This belief necessitated plans and preparations to meet the great emergency of a probable strike. But such a calamity the Directors were most anxious to avoid; and, with this object in view, a memorandum was submitted to the Board on the 30th of October, which, after referring to the bitterness of feeling, the suffering, and the loss that would result from a successful fight, went on as follows:—'Is there not a better way? Could not the Company, instead of fighting the men, use its money and efforts in making them its friends? Let the money that would be spent on a strike form the beginning of a fund for the men's benefit, to be increased in future by giving them every year a share in the profits of the Company, in addition to their wages—in short, apply the sliding scale to them, so that they, as well as the public and the shareholders, should have a share in the benefit resulting from reductions in the price of gas, on some such plan as the following scheme.' Then the profit-sharing scheme was explained practically in the form in which, the following week, it was heartily and unanimously adopted by the Board. The idea of breaking the Union was never even mentioned.

"Your demand for a withdrawal of the clauses 1, 2, 3, of the agreement can only be met by the remark that the stokers have left the service of the Company, and have thereby deprived themselves of all right or claim to discuss the arrangements the Company and its loyal men may find it to their mutual advantage to adopt. In this connection, it may be stated that the bonus scheme was offered to all the men on the same day. If the stokers had accepted it as promptly as the yardmen, the agreements would all have ended at the same time.

"The other point that requires an answer is your demand 'that all men who have come out go back without reservation or distinction.' The reply can only be that under no circumstances whatever will the Directors desert or act in the slightest degree dishonourably to any of the new men who have come to their help in this time of great difficulty. On this point, as on all others, the Directors are perfectly unanimous; not one Director is less firm or decided than any of his colleagues.

"The Directors deeply regret that the men have been so grievously misled; and they can only repeat their declaration that 'they will be glad, if vacancies arise, to give their old servants an opportunity of returning to their employment.'"

On Wednesday (Christmas Day) great preparations were made by the Company for the due celebration of the festival by the new hands. All the rooms used by the men were profusely decorated. Appropriate Christmas mottoes figured in large numbers, in frames made of holly and mistletoe; and there were also designs in paper flowers of a very creditable character. The Directors also marked the special character of the day by a present of oranges and nuts; while the tobacco allowance was increased. At the Old Kent Road, where meals for 1000 men a day are cooked, the preparations under the direction of the caterer (Mr. Walker) were naturally of a most extensive character. About 300 stones of beef and mutton were prepared and consumed; while the plum puddings—the special feature of the day's bill of fare—numbered upwards of 200. They were prepared in a wooden trough, 12 feet long by 3 feet wide; and many of the countrymen were allowed the privilege, at their own urgent entreaty, of giving the pudding a stir with wooden implements very much like oars. Those who were at work during the dinner time, from twelve to two, were supplied with that meal in the lobbies attached to the retort-houses; and all others dined in a new wooden building adjacent to the large holder. Tea was served with the dinner. When dinner was ready—upwards of 500 sat down at a time—the scene was very animated; the men eating with great appetite and relish. Many of the men spoke with evident delight of the approaching time when they would have their wives and children with them in London; and all of them declared that they had never before in their lives had such a "good time." The men who had not to work were paid as usual; the retort-house men at an extra rate for the eight-hour shift, and the yardmen double pay. In the evening there was an entertainment in the marquee. With the exception of a slight disturbance between some of the new hands and the late stokers at the Rotherhithe works, in which a young man was rather badly hurt, and which may lead to a prosecution of his assailants, the Christmas festivities passed off very satisfactorily at all the stations. All the new men (among whom are some stokers from Manchester) were found to be keeping well to their work; and expressed great satisfaction at the way in which they were being treated.

The Central Strike Committee had a meeting on Friday to consider Mr. Livesey's letter of the 24th; the result being that a reply, covering the main points in dispute, was sent late in the day. After quoting in full the "Agreement" and the "Notice to Workmen," which have already been given in our columns (*ante*, p. 928), the Committee said:

"We humbly submit that if no idea was entertained by you of breaking our Union, a more successful scheme was never promulgated to accomplish such an unintentional result. We ask you to consider the effect of the clauses 1, 2, and 3 of the agreement. By these a Union workman was to bind himself for twelve months, and to work in whatever capacity the foreman of the station ordered him (during that time), at the current wages applying to such capacity. Therefore, men earning 5s. 7d. per day on the signing of the agreement might, during the twelve months, be shifted to a reduced capacity (say) at 4s. per day, and so on downwards; and this work was to be done by the man 'at any one or other of the stations of the Company.' It is true, by clause 6, the Company undertakes that no alteration shall be made in the wages to the disadvantage of the men; but this clause only guarantees to the men the payment of wages as a class, when working in that class, at the rate paid to that class of labour at the date of signing the agreement, and does not bind the Company not to reduce the rate of wages paid to the man at the date of signing, no matter in what capacity he may be employed during the twelve months following. By clause 2 the Company could, to its own advantage, discharge all labourers but gas stokers through the slack season, and reduce the latter to the vacancies at reduced wages.

"Again, there is a more serious objection to the bonus scheme. It binds a labourer to work for five years before he could give six months' notice to draw his bonuses. Even a three-year-old labourer must wait two years more before he could give notice of withdrawal.

"The exception as to leaving the service of the Company entirely depends on the discretion of the Engineer of the station, who is to consider whether the services 'of such man can be dispensed with without detriment to the Company, and, if so, permission will be given at the expiration of such notice as the Engineer may deem sufficient.'

"From your letter the Company justify their bonus scheme on the ground of the doubtful character of the men, whose conduct, it is alleged, showed that they were ready on the slightest pretext to leave their work. This we deny emphatically; and we observe that, if true, such men were not worthy of kind consideration. The facts are the very opposite. There were grievances unredressed, and which remained unredressed, although assurances were given that they should be removed. They were not removed until action was taken by the men—their only remedy to unheeded complaints. Your letter admits the existence of the grievances, or there would have been no necessity to give assurances of removal.

"Your letter states, we regret to notice, that the Company was always ready to spend its money in fighting the men; and we say that the men have always been ready to discuss matters in a conciliatory spirit, and that they never have taken any strong step until all attempts in that direction have failed.

"We are of opinion that the profit-sharing scheme 'heartily and unanimously adopted by your Board' would have been materially altered in favour of the men had the same been submitted for consideration to representatives appointed by the Company and the men. This would have easily avoided the calamity the Directors were so anxious to avoid, and which, in their minds, could only arise from the doubtful character of the men.

"Some of the strikers have served your Company faithfully for years. On that ground alone you may rest assured that they have not taken the step you complain of hastily. The bonus scheme demanded of them five years of labour before they could give notice to claim a farthing of the bonuses. We do not forget the fact that they could obtain interest at 4 per cent. on the yearly bonus, payable half yearly; but if the principal was to be their own, why should it not be paid at the same time as the Directors received their fees for their labours for the year, and the shareholders were paid their dividends out of the profits realized by our labour? All these are matters of detail; but it will be noted that they were the only matters to be referred to a Committee to be presided over by the Chairman of your Company, and did not in any way affect or deal with the agreement, on the signing of which the labourer bound himself for twelve months to perform its clauses without any alteration or amendment, regardless of what the bonus scheme ultimately turned out to be on leaving the hands of the appointed Committee.

"Under the above circumstances, we think we are fairly justified in saying that the bonus scheme and agreement combined would result in breaking our Union; and on the face of them, as they now stand, the bonus scheme was exceedingly seductive and plausible.

"We again repeat that we are not opponents to the receipt of bonuses fairly given and fairly earned; but we do object to be bound for five years under a nominal agreement of service for twelve months before we can give notice to touch a farthing of a bonus reward.

"Lastly, there is the penalty of losing all bonuses in the event of a strike; so that it may be that after four years and eleven months another Chairman and another Board of Directors in office at the time may so act as to compel men to strike, and the Company would take again unto itself all the money set to the credit of the men on strike by way of bonuses, the result of their labour in increasing the profits of the

* It will be seen by our "Legal Intelligence" to-day that Wier has been apprehended on a charge of inciting to murder.—Ed. J. G. L.

Company and the dividends of the shareholders. The very mention of the word 'strike' in the clause in question is a fatal blow to the existence of our Union."

The foregoing letter was signed on behalf of the Committee by Mr. Hutchins and Mr. Davis, the President and the Secretary.

On Friday afternoon the whole of the Company's Superintendents met at the Old Kent Road Station, and presented reports. These were stated to be of a gratifying nature; but information considered by the Directors as of the greatest importance was an authentic statement, handed in by three of the Superintendents, to the effect that on the previous morning a small band of coal porters in the Company's service, who threw up their work a fortnight ago, requested to be taken on again. Mr. G. Livesey at once assented; and added, when one of the coal porters interviewed him, that there would be no spirit of retaliation on the part of the Company, and that bygones being bygones, those men who had thus returned to their work need not fear. With respect to Mr. Michael Henry's mission in the North of England, Mr. Frank Livesey stated on Friday that the Company were under no immediate apprehension of the supply of coal being cut off. Only that morning he had been advised that five fresh ships were on their way from Newcastle and Sunderland; and one of their own chartered vessels, which was manned by Union men, had been backwards and forwards three times since the difficulty began. Up to the present the Company had not taken steps to charter a single foreign vessel, though they had had many offers made to them; nor were they likely to accept these offers while their agent in the North was able to treat so lightly the threats which were being talked about.

With regard to the rumoured intended co-operation of the gas workmen on the north of the Thames with their fellows on the south, the Chairman of the Strike Committee stated on Friday morning that it would be with the greatest possible reluctance that the Executive would call out the men of The Gaslight and Coke Company; but it must be done as a last resort, if the South Metropolitan Company should persist in refusing to entertain the proposals by which the men at present out can return to work. "It must not be understood," added Mr. Hutchins, "that the Strike Committee wish Mr. Livesey to discharge the new hands in a body, but rather that they should be weeded out." He also averred that while the Union were not anxious to authorize a strike of The Gaslight and Coke Company's hands, the men themselves were desirous of coming to the help of their fellow-Unionists now on strike, and that some of their number were in communication with the Executive with this object. The following statement was, however, made to a reporter in answer to inquiries on this subject, at the Company's chief office in the course of the afternoon:—"As far as we know, our men are quite satisfied. We know of no intended strike; and up to the present time not a single notice from any of the men has been handed in. Though we have no reason to suspect any mischief of the kind, and should regret it for the sake of the men and the public, the Company are fully prepared to meet any emergency, and at most would suffer but temporary inconvenience should anything of the sort take place."

On Saturday Mr. Livesey sent to the papers the following statement in reply to the Committee's letter:—"It was unfair and misleading on the part of the President and the Secretary of the Gas Workers' Union, in their letter published to-day, to found their remarks and arguments on the original terms of the bonus scheme. Those terms, I may say, were unhesitatingly accepted by over 1000 men; but objections having been made by stokers and in other quarters to the clause involving forfeiture of the bonus in the case of a strike or wilful damage to the Company, it was unreservedly withdrawn. The stokers also objected to the retention of the bonus for five years. The Directors at once agreed to pay it annually to all men who wished to receive it, on giving reasonable notice. These and some minor alterations were made at the conference with the men on the subject on the 21st of November, with the desire to meet all the objections that, up to that time, had been raised, and notices of the revised conditions were posted up at all our works and in the lobbies of the retort-houses on the 23rd of November. The stokers cannot, therefore, plead ignorance as an excuse for the statements in their letter of yesterday. It was with full knowledge of these concessions that they, on the 4th of December, demanded that the bonus scheme 'be abolished, and the said men' (those who had signed agreements) 'be removed from the works.'"

The men held a mass meeting on Peckham Rye on Sunday afternoon; but the proceedings were something like the prevailing weather—extremely cold and dull. Mr. Hutchins was the first speaker, and he asserted that under the bonus scheme a Union man would never be safe; he would always be liable to be reduced to a lower position, with smaller wages. It was, he thought, plain that Mr. Livesey had been planning for this strike for some time. He had had agents out for months, getting men ready to take the places of the stokers in the event of a strike. These men had been brought up to London under false pretences. It had been said that the Executive of the Union had ordered the strike; but this was not true. It was the men alone who had to decide whether or not they should come out if they had a grievance; and the Executive could not stop them. He alleged that men now employed at the Vauxhall and Old Kent Road works had carried six-chambered revolvers in their pockets; and why, he asked, had they been allowed to do this? All the Unionists desired to do was to fight Mr. Livesey fair and square. The mover of the only resolution proposed—"That this meeting urges upon the trade organizations the importance of immediate help to assist us in our fight against the efforts of capitalists to crush our Union"—was Mr. Bailey, of the Southern Counties Labour League, who stated that was only a mock bonus scheme which Mr. Livesey had drawn up, and was intended to destroy the Union. It was not until the stokers began to help themselves, and obtained the eight-hour day, that Mr. Livesey came to the conclusion they were badly paid. Why did he not think of this when they were working from twelve to sixteen hours a day? The stokers had not had a fair fight. They had had to contend not only with Mr. Livesey but with the Government and public opinion. He alleged that the Manchester and Salford men had been brought up to London under misrepresentations. Mr. O'Connor, in seconding the motion, urged all trade unions to sympathize with the men on strike in a practical way, because if the stokers were defeated it would be a blow to trade unionism generally. Only the previous day the Union had sent home again 35 of the Machester and Salford men who were decoyed to London under false pretences, and who he declared were brought up in a drunken condition. Mr. Livesey was in a sad plight as far as his stock of gas was concerned; and the insides of the various works were, he had been informed, like hospitals. Mr. B. Ellis stated that the supply of gas had been very poor during the past three weeks; and in a week or two a movement would spring up among the tradesmen in the South of London that would rather upset Mr. Livesey's calculations. The succeeding speaker was Mr. Woodmansee, who said that next Wednesday week there was going to be a big deputation to the Camberwell Vestry, to make complaints with regard to the supply of gas and other matters. Mr. J. J. Richmond, of the Costermongers' Protection League, said he believed the bonus scheme was only introduced to deceive the men. The resolution was carried.

With regard to the rumours of a general strike of gas workers in London, the following letter, bearing the initials "H. D. E.," appeared in *The Times* yesterday:—"Will you permit me briefly to indicate a few facts which, to my mind, present very strong reasons for believing in the extreme improbability of a general strike of the gas workers on both sides of the Thames? (1) The men of South London out of work are at this moment largely dependent upon the contributions of the men of North London who are in work. If the latter are thrown out of work, not only are the southerners deprived of their contributions, but the aggregate number of men requiring contributory support is multiplied fourfold, while at the same time the source of contribution is annihilated. (2) The ostensible object of the suggested general strike is to put pressure upon Mr. Livesey's Company, for the northern men have now nothing in dispute with their own Companies. But if the northern men go out, they will not thereby put the slightest pressure upon Mr. Livesey. They may injure their own Companies, the source from which they draw their daily bread. But, assuming that this suicidal act were even so completely achieved as actually to stop the northern Companies from making gas, the only effect upon Mr. Livesey would be absolutely beneficial, because: (*a*) The cessation of work at the northern Companies' stations, and the consequent check to the demand for coal for carbonization, would afford Mr. Livesey vastly increased facilities, not only for loading his own coal at the ports of shipment, but in the procuring of coal generally. (*b*) With the cessation of gas making at the northern Companies' stations, it comes necessarily that the production of coke and other residuals from carbonization ceases also. This would give Mr. Livesey a monopoly of such production, which he could turn to very good account. The men's leaders may not be perfect Solomons of wisdom, but I fancy they are quite sagacious enough to avoid committing such a blunder. As to the idea of producing such an intolerable state of public damage, discomfort, and loss as to compel Mr. Livesey to dismiss his faithful men—a pitiful parody of Egyptian plagues to drive the Pharaoh of the Old Kent Road to 'let the people go'—it is to my mind colossal, pernicious, neuralgic nonsense."

The Position of the Strikers in Manchester and Salford.

Active steps were taken early last week to obtain funds for the relief of the distress caused by the men who had thrown up their employment at the Manchester and Salford Gas-Works; and to this end applications were made to Mr. C. Nickson and Mr. S. Y. Shoubridge respectively for particulars as to the number of hands displaced. The latter gentleman stated that, as far as his works were concerned, of the 350 men who had gone out, 275 had applied for re-engagement, of whom 32 had been taken on, and probably more would follow. With regard to the position of the Manchester and Salford branches of the Union in relation to the central body, it will be best explained by the following communication from the London Correspondent of the *Manchester Guardian*, written on the evening of the 21st inst.:—"This morning I had an interview with Mr. W. Thorne, General Secretary, and Mr. W. H. Ward, Assistant Secretary of the Gas Workers' Union, at the Society's offices. Mr. Canty, a member of the Executive, who was about to proceed to Manchester on behalf of the Union, was also present. Mr. Ward, who was at one time a stoker at the Rochdale Road works, expressed sorrow at the situation of the Manchester men, but refused to accept responsibility for the Gas Workers' Union, which by its rules requires all members to serve six months on probation before being entitled to benefit. The Manchester men have not belonged to the Union half that time; and even if they had, would not have been justified in taking the extreme step of giving notice to leave work without the consent of the central body. Mr. Thorne visited Manchester previous to the strike, and has been constantly in communication with the leaders there; but he received no intimation of the men giving notice until three days after they had already done so. During the week two members of the Executive have been in Manchester investigating the origin of the strike; and from the communications they have made to the Secretaries, these officials are agreed in attributing the hasty and disastrous step taken by the Manchester men before their branch had acquired any considerable strength to the excess of zeal on the part of their local Organizing Secretary, Mr. Horrocks. They speak in kindly terms of the enthusiasm and energy he has thrown into the work; but they blame him severely for leading the men to believe that the Union, with its 60,000 members, would support them in any line of action they decided upon. Such support should, according to their rules, be given only after an investigation had been ordered by the Central Council and a vote of the members taken, after the fullest consideration of both the circumstances of the case and the position of the Society. The meeting at which it was determined to give notice to the Corporation was somewhat irregular and excited, and the relation to the parent Society and the need of consulting it were ignored. The officials are anxious that the Manchester men should keep up their organization on sober lines, and will do all in their power to help them. As an earnest of this, they have to-day sent on a cheque for £200; though at present, with the South Metropolitan dispute in progress, there are large calls upon them."

By the end of last week the normal condition of the gas supply in Manchester and Salford had been thoroughly re-established. In the former place, nearly all the new men had quitted the works for their own dwellings, only a few, who preferred to take advantage of the free lodgings provided for them, remaining. At a meeting of the Canon Stowell's Relief Fund Committee on Thursday, it was announced that £156 had been subscribed for the families of the unemployed men.

The Labour Movement in the Provinces.

It now remains to complete our chronicle of the progress of the labour movement in the provinces generally, which has been interrupted by the extended notice claimed by the important phases of the agitation which have during the past few weeks divided our readers' attention fairly equally between the Metropolis and Manchester. At Bath, an application was made about the middle of the present month for a rise of 6d. per shift of eight hours (from 4s. 6d. to 5s.), together with certain other privileges. These were all considered by the Directors of the Company, and granted, although it was stated that the concession would involve an increase in the price of gas. The men employed at the Birkenhead Corporation Gas-Works recently formulated certain demands, and submitted them to the Gas Committee, who conceded them all except on a few minor points. The eight-hour shift was asked for; time-and-a-half for Sundays, double time for Christmas Day and Good Friday; the wages of the yardmen to be increased from 21s. to 22s. per week; and the stokers to have facilities for washing themselves and changing their clothing before leaving the works. The men expressed their satisfaction at the result of their movement. The Gas Committee of the Bolton Corporation have agreed to the demands of the men—viz., if they stoke above 2 tons of coal per day, they shall be paid 1½d. for every extra cwt., instead of 1d. as offered by the

Committee; also have double pay for New Year's Day, instead of time-and-a-half as offered by the Committee. The men have now an eight-hour working day for 5s.; three days' holiday during the summer; double time for Good Friday, Christmas Day, and New Year's Day; and 1½d. for every extra cwt. stoked above the 2 tons per day. The labourers have an advance of 2s. per week; and the Committee have agreed to provide wash-houses and dining-shed for the men on the works. The stokers in the employ of the Burnley Corporation, who forwarded a memorial to the Gas Committee a short time ago with respect to their wages and other matters, had a conference with the Chairman of the Gas Committee, with the result that an amicable settlement was arrived at. The men demanded ½d. per cwt. advance; double pay on Christmas Day and Good Friday; and a week's holiday in the year. The arrangement settled was a concession of ½d. per cwt., and double pay on the days asked for; but the Committee refused the week's holiday. The men complained more particularly about being overworked; and the extra pay will enable them to engage wheelers. Financially they will be no better off; but they will now have less work. At Chester an advance equal to something like 25 per cent. has been made in the stokers' wages, with extra pay for Sundays and holidays. The Dukinfield Local Board have granted an advance of 1s. 6d. per week, with twelve-hour shifts. After making certain concessions to the stokers and other workmen in their employ, the Heywood Corporation Gas Committee have had to meet and deal with a second and larger demand. The men insisted upon the entire abolition of the twelve-hour shift system, and the allowance of time-and-a-half for Sunday work. At a meeting of the Town Council held specially yesterday week to consider the matter, the whole question was discussed with the Manager (Mr. W. Whatmough). In the end, it was decided to concede the two points mentioned; the men waiving the claim they had made to double time for Christmas Day, New Year's Day, and Good Friday. At Macclesfield the rates of wages per day have been fixed as follows:—Foremen stokers, 5s.; stokers, 4s. 3d.; wheelers, 3s. 8d. and 3s. 10d.; stackers, 3s. 4d. and 3s. 6d. Sundays, Christmas Day, and Good Friday to be paid for at time-and-a-quarter. At Mansfield the wages of the stokers have been advanced 6d. per day (making 4s. 6d.); Sunday labour to be dispensed with as far as possible. At Mossley the stokers are in future to receive 5s. 6d. for carbonizing 40 cwt. of coal, with eight-hour shifts, instead of for 42 cwt. and twelve-hour shifts. The yardmen are to work 50½ hours per week for 22s.; the old rate being 55½ hours for 20s. All permanent men are to have double time for Christmas Day, Good Friday, and New Year's Day; and a week's holiday in the year; time-and-a-half for Sunday, and time-and-a-quarter for other overtime. The stokers at the Nottingham Corporation Gas-Works petitioned for better terms; and the matter at one time looked very like leading to a strike. Eventually, however, the terms offered by the Gas Committee were accepted. The stokers under the new rates receive an increase of 6d. per day, and will be paid time-and-a-half for Sundays from 6 a.m. to 10 p.m., and double time on Good Friday and Christmas Day. It is estimated that the total increase in each stoker's wages is about 5s. 3d. per week. The yardmen and general labourers have received an advance of about 2s. per week. A washing and mess room has been supplied at each station. The request of the men that they should be relieved of the fires the Committee were unable to grant; and therefore the amount of the work to be performed remains practically unaltered. The Gas Committee of the Rochdale Corporation have granted their stokers eight-hour shifts, with 42 cwt. of coal to be carbonized in each shift, in place of 48 cwt. in twelve hours; time-and-a-half for Sunday work; and double time for Christmas Day and Good Friday. Advances have been made in the case of other workmen. The charges are estimated to entail an additional expenditure of £1518 per annum. The Rossendale Union Gas Company have increased the wages of their stokers 15 per cent., and advanced their labourers' pay from 21s. to 22s. per week. The notice given by the Stalybridge men, a few weeks ago, of their intention to leave their employment was fortunately not carried out; the threatened strike being averted by mutual concessions. Twelve-hour shifts are continued; but the stokers are to receive 5s. 6d., instead of 5s. per day, with double time for Christmas Day and Good Friday. The labourers are advanced from 20s. to 22s. per week. The demand for time-and-a-half for Sundays and a week's holiday once a year, was not insisted upon by the men. At Stockport the stokers a short time ago had an advance of wages equal to about 3s. per week, and the barrowmen one of 2s. per week, with twelve-hour shifts. They afterwards, however, applied for a reduction of hours to eight. This the Gas Committee were unable to concede; but they offered an additional 3s. per week. We believe this has met the wishes of the men, and will come into force with the New Year. At Walsall the Gas Committee recommended the Corporation to grant various concessions to the workmen, amounting altogether to about £2500 a year—equal to a rate of 5d. in the pound, or 4d. per 1000 cubic feet in the price of gas. The concessions were of a nature similar to those granted in other places; and some were to come into operation as from the 1st inst., the others with the New Year. The Warrington Corporation Gas Committee are amongst those who have lately come to terms with their *employés* on the wages question. The eight-hour shift and an increase of wages was demanded. The Committee have advanced the wages of the stokers at the Mersey Street works by 5s. a week, the hours to remain at twelve per day. At the Longford station the work has been somewhat reduced; and the men receive an addition of 1s. 4d. per week to their wages. Double time is to be paid for Christmas Day and Good Friday. The Wigan Corporation have conceded the demand of the gas stokers and firemen for an advance of wages. The stokers have been allowed an increase of 6d. per day of eight hours; and the firemen an advance of 4d. per day of twelve hours.

An Old Trades Unionist on the Leaders of the Agitation.

[From the *Evening News and Post*.]

During the progress of the great labour movement which has been going on in the Metropolis for some months, inquiries have from time to time been made, especially by people who have figured conspicuously in trade and other disputes, as to the capacity of the men who have constituted themselves the leaders of the present agitations. The "veterans" in the ranks of Trades Unionists—men whose claim to be the real and responsible leaders of labour has never until recently been disputed—look, we believe, with anything but approval upon the methods adopted by the younger aspirants to the position. The men whose names have long been familiar words at Trades Union congresses do not hesitate to say that those who have recently come to the front are almost as certain to do harm, and as little likely to do good, as an inexperienced child in possession of a loaded firearm; and they hold aloof somewhat sternly from what they look upon as falling little short of an indulgence in criminal folly, sure to plunge a large number of working men into misery, even if it does not bring the principle of trades unionism into discredit. With the object of finding out to what extent these feelings of disapproval are held, and how far they are likely to be operative in the near future, our representative last week interviewed several recognized Trades Union leaders. The interview with one of these gentlemen opened with the very natural question as to how it was that his name, and those of his colleagues, well-known Unionists as they are, had not been heard in connection with the recent troubles—the dockers' strike, the strike at Silvertown, and those in South London and Manchester.

"You must distinguish a little, if you please," said the gentleman addressed. "We showed our sympathy with the dockers in a practical way by subscribing to their funds; and we should have rendered personal help if we had not been warned off by Burns and others, who looked upon the strike as a sort of close preserve with which no one had a right to meddle but themselves. We were insultingly told that we were not wanted; and you will scarcely be surprised to hear that, after that, we did not push ourselves forward. With regard to the Silvertown strike and the gas strikes at Manchester and on the south side of the Thames, they were foredoomed to failure; and I would not willingly have mixed myself up with them in any way, though no one can be more sorry for the poor misled men than I am. These strikes were undertaken without thought or preparation, and without any just or valid reason."

"You think the men were not strong enough to strike?"

"Strong enough? They had no strength at all; and they had practically nothing to strike about. Take the gas stokers. They have only had a Union some nine or ten months—scarcely time enough to get on their legs—and yet during that period they have been in continual hot water with the companies. When they perpetrated their culminating folly of calling out the men in South London and Manchester, they had practically no funds—certainly, I should say not enough to keep up a reasonable strike allowance for more than a fortnight. They had made no arrangements to receive effective support from other and wealthier Unions; they utterly miscalculated the forces they had to fight against; and they entered upon the struggle at a period of the year when defeat meant the greatest possible amount of suffering to the greatest possible number of their followers. They committed every mistake they could commit, and were wrong from top to bottom."

"Which do you mean—wrong in principle, or only as a matter of tactics?"

"Wrong in both ways. Gas directors are the best fellows in the world to deal with, from their workmen's point of view. They are only allowed to declare a certain amount of dividend; and when this has been done, they have absolutely no reason for refusing their workpeople a haul at the surplus profits, whether in the shape of increased wages, shorter hours of labour, or a direct share of the profits in the form of a bonus. Why, it is but a very few months ago that Mr. Livesey and other managers conceded the eight-hour shift. The working shift had previously been twelve hours; and at one drop this was reduced to eight hours, without a penny being taken off the wages. To insist on rushing to extremes with men who are willing to make such enormous concessions as this, is worse than folly; it is absolutely criminal."

"But the gas stokers say that they only kicked against the bonus scheme and the twelve months agreement, which were directly aimed at the existence of the Union."

"I do not believe it. I have known Mr. Livesey for years as an opponent, and I always found him a fair man. I do not suppose he cares twopence whether his men are Unionists or 'blacklegs,' so long as he gets his work done. But even assuming that the so-called leaders of the gas men are right in their contention, what fools they must have been to plunge into a strike in the way they did. There were a thousand pleas on which they might have temporized and carried on negotiations. If they had gone about their work in a common-sense way, I have no doubt that they could have arranged for monthly instead of twelvemonthly notices, with a further arrangement that in the event of a strike all the men should be able to leave at once. Of course, this would have taken time; but how much better it would be for the men if they were at work now, and carrying on these negotiations, instead of being out on the streets, with scant prospect of being taken back."

"Do you know anything personally about these 'so-called leaders,' as you term them?"

"Nothing at all. I never even heard of their names until within the last week or two. They are just a set of mushrooms who spring up to-day and will be gone to-morrow. And yet these and similar fellows are the people who vilify men like myself and others who have fought the battle of trades unionism for almost a couple of generations; who maintained the right of the men to combine, when to do so meant a great probability of imprisonment: who won that great battle after years of hard work; who have year after year steadily consolidated the position they then won, by pressing on amendments of the laws, by guiding the mass of Unionists with wisdom and discretion, and most of all, perhaps, by keeping our eyes steadily fixed upon one goal—the permanent well-being of our followers. When we turn to the other side, and look at these men of buckram, who are posing so grandly to-day, it is enough to make one laugh. Will you believe it, these mushroom Unionists who are so bitter against 'blacklegs,' were 'blacklegs' themselves five minutes ago, and 'blacklegs' of the worst type. Many of them have worked for years as 'rats,' and would certainly not have been accepted as members by any decent and old-established Union. Yet they have now the coolness to put themselves forward as the only friends of the working man. Judge them by their works. They succeeded in the dockers' strike by the skin of their teeth, simply because of the magnificent gifts from Australia. That help was totally unexpected. They had no more right to count upon it than they had to count upon miraculous assistance from the clouds; but if it had not come in the nick of time, they would have lost all along the line. Against this solitary, and in some senses undeserved success, we have to put the ghastly failures at Manchester, Salford, Silvertown, and South London. Wherever they have had to trust to themselves, they have failed, and inflicted terrible suffering upon their followers. True safety is only to be found in the old and well-tried lines of trades unionism; and no true friend of labour will encourage the workmen to go outside those lines."

Proposed Purchase of the Newark Water-Works by the Town Council.—A special meeting of the Newark Town Council was held yesterday week, to discuss the action to be taken by the Corporation, in view of the notice given by the Water Company that they intended to obtain an Act of Parliament to enlarge their powers and undertaking. The minutes of the Committee appointed to consider the subject were read, from which it appeared that they were of opinion the water supply should be in the hands of the Corporation. They recommended that negotiations should be entered into with the Company for the purchase of their concern; also that a petition be prepared against the Bill to put the Council in a proper position to oppose it. Alderman Pratt moved the confirmation of these minutes; and Alderman Hole having seconded the motion, it was agreed to with very little discussion. A Committee was subsequently appointed, to negotiate with the Company for the acquisition of the undertaking, with full power to purchase it at such a price as they thought fit, and, further, to take steps to oppose the Company's Bill.

CHRISTMAS TIME AT THE YORK GAS-WORKS.

On Saturday, the 21st inst., Mr. Charles Sellers, the Secretary and Manager of the York Gas Company, gave his usual Christmas address to the workmen. He commenced by wishing them all "A Merry Christmas and a Happy New Year;" remarking that though they might regard the wish as a formality—which he admitted it was—he thought that as they grew older, and looked back over the years many of them had worked shoulder to shoulder with him, these old customs and memories should be kept alive. He then proceeded as follows:—Before dealing with personal matters, let me say a word upon the work by which we get our daily bread. There is, perhaps, no industry just now more attacked than the gas industry. It is attacked in the open field by fair competition, which we can respect; and it is attacked by paid enemies, who do not scruple to use falsehood and misrepresentation to injure us, and who skulk behind the hedges and shelter of the press—and in many cases, I am sorry to say, a venal press. But we can afford to rest our industry upon the survival of the fittest, for upon that law must all lighting competition be ultimately decided. And I venture to tell you, upon the opinions of the best authorities upon electric lighting and gas lighting, that when the present excitement shall have passed away, and the scares and fears which unscrupulous men create, by playing upon the timid and the ignorant, shall have ceased to exist, the gas industry will be safe, and the public verdict will acknowledge that there is room for all. Not only, however, may mischief be done to our industry by outsiders; it may be done by those within our own ranks. But so long as I occupy my present position amongst you, I trust that the same amicable relationship will continue to exist between the Directors and ourselves as exists to-day. For we must never forget that whilst our employment is permanent, there are men who just now are tempted to lose their heads by the flush in trade, who but a few years ago were suffering severely from trade depression; and we may depend upon it that this same trade depression to which I have alluded, will as assuredly come again as that night follows day. And now let me say a word or two about personal matters—fireside matters, if you like. There is one subject upon which all family comfort depends, and that is thrift. Love in a cottage is doubtless charming. But you will all agree with me that love cannot feed upon poverty; for, proverbially, "When Poverty comes in at the door, Love flies out of the window." In fact, the happiness of a home is always in danger where people live from hand to mouth, and where a man has not the wit to see that he cannot have his cake and eat it, or keep the money in his pocket for a rainy day and drink it. In a word, then, I want you all to be thrifty. Save something, anything; but save something. It is thrift that has built our railways, our factories, and our gas-works; and it is thrift that gives employment to the swarming millions of this country, and that makes England the leading workshop of the world. Let us, then, be just to capital, and never regard it in any other light than as being our best friend. It is thrift, too, that has put our ships upon the seas; that has girdled the earth with electric bands; and that to-day gives a broader basis and an assurance for a higher humanity. And, lastly, it is thrift that gives plenty to our homes, that makes our firesides warmer and brighter, and, coupled with

> "Joy, and temperance, and repose,
> Slam the door on the bailiff's nose."

I want you, then, to be thrifty, and, above all things, to look well to the education of your children, and not be misled by red herrings which may be trailed across your path. I want you also to join me heart and soul in denouncing every drunken fool who brings discredit and disgrace upon your good name. And, finally, I want the whole staff of the York Gas-Works to keep up the high reputation it at present enjoys throughout the gas world, of standing in the front rank of sensible British workmen—of men who endeavour to leave the world better than they found it; of men who defend their hearths and homes by sobriety, industry, and thrift; and who make themselves worthy of being covered by the text that the industrious man shall "stand before kings."

Mr. Sellers concluded by wishing the men, and their wives and families, a happy Christmas; and then distributed his usual Christmas gifts of toys, books, and useful articles of dress to all the men who had children; intimating that his Directors had this year personally contributed to the cost, and felt as much pleasure in the little ceremony as he did himself.

JOHANNESBURG GAS COMPANY, LIMITED.

The Statutory General Meeting of this Company was recently held in Johannesburg—Mr. Sivewright, M.L.A., in the chair.

The Chairman remarked that this was the first general meeting of the Company, and was almost a purely formal one, held in compliance with the Articles of Association. At the same time he was glad to meet the shareholders, if only to have the opportunity of laying before them a brief statement as to the actual position of the concern. Although the Company had not been in existence six months, he could point to a very satisfactory record of work done in that brief period. The Board had been most unremitting in their attention to the interests of the Company; and their efforts had been so heartily seconded by the London agents, Messrs. Soper and Davis, and their Consulting Engineer, Mr. Thomas Newbigging, that they could fairly lay claim to not having permitted the "grass to grow under their feet." All the machinery and plant were either on the sea or landed in South Africa. While waiting the arrival of the machinery and plant, they had not been idle; for anyone who inspected the site of the Company's works would see what had been done. He would see there structures raised which were second to none on the Witwatersrand Gold Fields. Mr. W. Carr, the Clerk of Works, had carried out the duties he had to perform in a manner which did not belie the high expectations raised as to his capabilities. He had laid out a scheme so as to have all the works completed before commencing to lay the mains (some of which had already arrived); so that when the pipes were laid down, the gas could be brought along with them—thus testing the manner in which the work had been executed. In this way the possibility of leakage was reduced to a minimum. In reply to a question put to Mr. Carr by the Board only the previous day, he expressed himself confident that gas would be in Johannesburg by July next. It was not necessary to say anything more about the works inside the town. There were, however, one or two facts in connection with the Company which the shareholders should know. One was that they had secured on terms (in respect to which there was only one opinion—that they were favourable) the lease, with the option of purchase, of a mine, the coal from which Mr. Newbigging pronounced to be second to none of those which he had seen in South Africa, and equal to some of the best English gas-producing coal. The Company would not have any rent to pay for the mine until January. In the meantime, the services of Mr. Marshall, a practical miner, who was specially selected by Mr. Newbigging, had been secured; and he would commence operations at once. This was a very important fact in the present days of Coal Trusts; for it showed they were entirely independent, and could mine and procure their own coal on the spot in a very satisfactory and inexpensive manner. A second fact was that the Company had secured the exclusive right for the "Otto" gas-engine from Messrs. Crossley Bros., the holders of the patent and manufacturers of the engine in England. This would prove a valuable asset to the Company in connection with the use of gas for motive power, for which there seemed an unlimited field before them. Nor was this the case only with gas used for motive power. For cooking and household purposes they could plainly see there would be a large consumption. They had likewise all the residual products to rely upon. Then there was the revenue from the lighting, to which they could with confidence look forward. There was no financial statement to lay before the meeting; but at the same time one had been prepared which was open to the inspection of the shareholders, showing how the capital up to date had been employed. The working capital was £71,000; but they had paid the Government of the South African Republic £1000, which remained on fixed deposit, and was an asset to the Company which would be repaid to them on the expiration of the concession. A very large portion of the £70,000 had already been expended in the purchase of materials in London, and for freight, as well as in the permanent works which had been already executed. They had on fixed deposit £10,000, with £723 in the local bank current account; whilst in London they had a balance to their credit of close upon £22,000. Notwithstanding the large amount they had in hand, there could be no question about their requiring more money for the completion of their works and plant. But the shareholders need not be alarmed about this; for the Board were satisfied there would be no difficulty in obtaining it by the issue of their reserved shares. A working capital of £70,000 was considered liberal when the Company was started; but the marvellous growth of Johannesburg, and the enormous fields already opened up and expanding every day, rendered it not only desirable but necessary that provision should be made for works being constructed of far greater capacity than was anticipated. In conclusion, he said he did not know of one company in Johannesburg that formed a better investment or held out brighter prospects for the future than their own.

THE FINANCIAL ASPECT OF NATURAL GAS.

A recent number of the *Financial and Mining Record* contained an article, by Mr. C. Harrison, dealing with the above subject. The following are extracts therefrom:—

Although the natural gas industry is in its infancy, being but seven years of age in Pittsburg, the pioneer city, it has had an important effect on commercial enterprise and economic conditions. Throughout the whole area of natural gas production, from Western Pennsylvania to the fields of Indiana, manufacturing has been stimulated, and the production of manufactured commodities and the consumption of raw materials vastly increased, the effect of which is not limited to the gas-producing territory, but is diffused throughout America. The commercial phases of the industry, the advantages arising from the use of such fuel to manufacturers, the comfort and convenience added to the homes of the people, the advancement in material wealth, additional employment to labour, and various other attributes of a substantial nature, have been widely discussed and generally understood. But the purely financial considerations attending this new industry and enterprise have, as yet, taken form so little removed from the speculative and experimental as to make definite conclusions nearly impossible. Financiers have nevertheless had considerable experience with the stocks of corporations engaged in the industry. Bonds issued in furtherance of such enterprises are occasionally offered; and order is so gradually emerging from chaos, that indications of permanent truth and reliable principles are making their appearance.

The first feature presenting itself to financial consideration is that the industry has, from its inception, been in the hands of companies or corporations. Individuals have leased territory and produced gas, and they will probably continue to do so; but in all States wherein natural gas has been utilized as fuel, the distribution has been made to consumers by incorporated companies. One leading reason why this must continue to be the case is that the places of production are at considerable distance from the places of consumption; the intervening territory being occupied and owned by many persons. In order to obtain rights of way for the pipes through which gas can be conveyed, the power of eminent domain is frequently essential, and this is conferred on corporations exclusively. There is no probability that natural gas can ever be successfully handled by private individuals. A large number of corporations have accordingly been organized to conduct the business. Their stocks have been on the public markets; and their values have become, to some extent, known through the quotations obtained from trading in them. The market has varied widely; the same stocks fluctuating between 135 per cent. of their par value and 32 per cent., often without material difference in their dividend-earning capacity, the regularity of dividend payment, or any other known reason than speculative causes. At present, to find a natural gas stock on the market worth par is a decided exception, notwithstanding the fact that several have been paying dividends of from 9 to 12 per cent. per annum regularly for a term of years, and are still in a position to continue them.

All natural gas stocks are speculative, and subjected to so many influences against which no human foresight can afford protection, that, however valuable they may be as immediate profit-payers, they have never risen to the dignity of legitimate investments; and there is no prospect that they ever will. They cannot, for many years at least, from the fact that the sources of supply are beneath the earth, where the human eye can never penetrate; and, unlike many other mining operations, the extent of the "vein" or "lode" cannot be even surmised, much less surveyed. That the wells from which the supply is obtained are really exhaustible, howsoever great may have been their output or uniform their pressure for years, has become a demonstrated fact. No inexhaustible natural gas well has yet been discovered, or one which has not suffered a diminution of pressure, though this fact was denied only a few months ago. Increasing demand upon productiveness has led to more rapid exhaustion; and the rate at which companies have been compelled to seek new territory has been accelerated.

All the great companies, a few years ago, were supposed to be in possession of territory practically inexhaustible; but there is scarcely a great company in existence, after five years of experience, that is not seeking new territory on account of diminishing supply from those fields which promised to be permanent. That several of the companies have been successful in finding new and prolific territory, is matter for congratulation to the stockholders; but such extensions involve expenditure not contemplated in the earlier days of the enterprise. It is evident that the wells cannot be brought to the pipes; the pipes must therefore be extended to the wells. Every new well drilled, and every foot of pipe laid to make its production available (if, indeed, there be any production), causes an additional outlay of capital which would not have been the case had the wells been originally inexhaustible, as contended. New territory adds still more to the disbursements of the corporation, whether it be obtained in fee or on royalties; and the extension of the pipe system is generally

much greater to new territory than from line to well in territory already in possession. It therefore becomes a matter of interest in some cases as to whether these extensions of the pipe-lines of companies to new wells in the old or in new territory, and the new wells themselves, which have been found to be imperatively necessary to the successful operation of the plant, should be charged to the stock or the expenses account. It is in dispute and undecided; but in cases of leased lines, it makes a vast difference where a division of profits is made the basis of rental. Natural gas may be inexhaustible in the aggregate; and the supply may be all that is claimed for it by the most sanguine of those engaged in the industry. But the extension of lines and additional expense on account of the exhaustion of wells in all known fields, is a truth too well established to be successfully refuted. How far this may have to be continued, with what rapidity it may be required to supply the demand in the future, cannot be known. This very element of uncertainty will always keep the financial aspects of the industry purely speculative, and render it impossible to attain such a settled condition as to make a legitimate investment, or the stocks of the companies such securities as a court would order trust funds to be invested in, whatever present profits or prospective gains of particular companies may be.

From an economic point of view, it is evident that the cost of production of natural gas must increase as long as wells are exhaustible. Territory becomes scarcer and more uncertain, and the plants of companies larger and more expensive to maintain and operate. At the same time the price to the consumer cannot be arbitrarily advanced to meet this increased cost of production, because there has been no exhaustion of coal-fields nor of means of transportation. As much solid fuel of all kinds is within as ready reach of consumers as was the case before natural gas was introduced as fuel; besides which new competitors have appeared in the market. The prolific oil-fields of Ohio, particularly, have been utilized for fuel purposes, since natural gas was introduced, and they make a highly-successful competitor where conditions are favourable to its supply and gas has to be piped a long distance. Besides oil as fuel, manufactured fuel gases are being devised, and have already supplanted coal in some localities. They are claimed to present nearly as desirable economic features as natural gas itself. Competition must prevent any great advance in the price of natural gas. With constantly and inevitably increasing cost of production, and no opportunity for a corresponding cost to the consumer, what is to prevent ultimate bankruptcy of every natural gas company? Clearly, nothing but the economies rendered possible by experience in distribution, or increasing its effectiveness in use. By the knowledge which comes from experience alone can they be saved. The number of gas companies already rendered insolvent, sold out by the sheriff, or absorbed by other more prosperous companies, is a practical suggestion that it takes something more than gas-producing territory, a pipe-line, and customers to make a successful natural gas plant. Not a company went into operation without all these, but the number of financial wrecks is very large for the length of time the industry has been in progress, and the supposed profit there is in the business. The great problem is whether the advantages of skill and information derived from long experience in the production and distribution of natural gas will be able to keep pace with the continued cost of production. Whether it be possible or not, the conclusion is unavoidable, that the longer the natural gas industry is continued, the more hazardous it becomes for inexperienced persons to embark in it.

The petroleum industry was long recognized as being the most uncertain and speculative of mining operations; but natural gas is even more speculative than petroleum. All the uncertainty in the production of oil is present in the production of natural gas; but in oil the uncertainty ends. Petroleum has a market throughout the world. Gas has no market except at the end of the pipe. Petroleum having been procured, a variety of ways of transportation are possible. If in barrels it becomes too expensive, the tank car is available; if the tank car costs too much, the pipe-line can be laid down; or the reverse order may be resorted to in extremity. But in handling natural gas, but one means of transportation is possible. In natural gas the place of consumption is fixed. No further can it go to get a better price. It has all the disadvantages and uncertainties of oil; while in points of conveyance and market it has none of the advantages. In 30 years petroleum has never ceased to be a speculative commodity; the stocks of the companies engaged in the enterprise equally so. Natural gas companies must be even more of a speculative nature for a longer period, if they continue for that length of time.

Besides their stocks, the bonds of corporations engaged in the natural gas business have a degree of financial interest. The amounts thus far issued have been small, and all issues have been under such conditions as to present little from which satisfactory estimates can be formed of the value of such securities. So far as is known, there has been no uniformity in the issues of bonds by various corporations; and the conditions under which they have been made were so entirely dissimilar each to the other, that only general principles can be relied on in approximating the value of any particular class. The value of a bond depends principally, first, on its validity; secondly, on the credit of the corporation issuing it; thirdly, on the market value of the collateral security or tangible property pledged for its redemption; fourthly, on the rate of interest it bears, and the length of time it has to run. Natural gas companies organized and doing business in Western Pennsylvania have issued bonds, but they have been placed through private agencies on private terms, so that very little is publicly known of the value that has been placed upon them. It may be said, however, that the validity has never been questioned seriously; the companies issuing them having been regular dividend-paying institutions as a rule, and hence of good credit. Each company has mortgaged a plant costing far more than the face-value of the bonds to secure the payment; and so ong as there is a supply of gas, the collateral security is probably unquestionable. But from the exhaustibility of the wells from which the supplies are obtained, the comparative worthlessness of a pipe-line having nothing to fill it with, and the constantly increasing expenditures of established companies more particularly pointed out above, the general rule, that the longer a bond has to run the more valuable it is, does not necessarily apply to natural gas securities. Besides these considerations, the risks of the business are so great, and its speculative character so pronounced, that a high rate of interest becomes essential to indemnify against the contingencies of the investment. The securities issued by a corporation partake, to some extent, at least of the speculative character of the business in which it is engaged. The business risks and expenses of a municipality are at least as great as those of a business corporation, and are liable to be much more so. Natural gas trustees are generally gentlemen of success in their vocation, but without practical knowledge of the details of production or distribution of natural gas. Practical affairs inevitably become more risky under inexperienced management than under the direction of experienced men. Bonds issued by a municipality under such management, and having nothing but public credit behind them, cannot be so desirable as those issued by business corporations, whose affairs are conducted by persons of experience in every department, and which give collateral security on their tangible plants as well as the security of experience and actually invested capital.

Municipalities do not invest capital in these natural gas plants. The capital is borrowed on bonds sold. They have been uniformly introduced by a class of persons who desire to "boom the town;" who desire to induce manufacturers to locate in the city or in its suburbs under the proclaimed advantages of "free gas" or "cheap food," at least, provided largely at public expense. To borrow money wherewith to erect a charitable institution, or one to be conducted without profit, cannot enhance the value of bonds upon which such capital is borrowed. Experiment has shown in a number of cases the effects of municipalities entering upon the natural gas business. Besides the creation of a bonded indebtedness for the construction of the plant and setting it in operation, the expense of operating has caused a deficit to be supplied by taxation. At first, prices to consumers are reduced so that trading corporations are forced out of business; and the price is then advanced often to twice the rates charged by the business concerns. Excitement has run riot for a time, values of real estate advanced, and tracts have been unloaded at high prices on favourable terms to taking it back on the mortgage. Manufacturers have been led to locate there merely to find the gilded promises but empty bubbles from the natural cause of failure of supply. Cities claiming to have "gas enough for all the world" a couple of years ago, were chilly last winter for want of fuel; and councils are called upon for further appropriations for funds to put the plants in order for the coming winter. In some cases the bonding has been done without the authority of the law; in others the requirements of the law have been complied with in appearance, but by evasions of the most questionable character. Any subterfuge to reach the end of issuing the bonds and marketing them, appears to have been "winked at" under the enthusiasm of the moment and popular clamour.

It is only recently that the great question of the legality of such proceedings as these has been seriously called into question. The whole subject has been brought up in the form of legal proceedings in the city of Toledo, where it is proposed to construct and operate a natural gas plant by the Municipality. In January of the present year, the Legislature of Ohio passed an Act entitled—"An Act to authorize cities of the third grade of the first class to borrow money, and issue bonds therefor, for the purpose of procuring territory and right of way, sinking wells for natural gas, purchasing wells and natural gas-works, purchasing and laying pipes and supplying such city with natural gas for public and private consumption." Under the provisions of this Act, an election was held in April last; and a majority of the voters decided in favour of the bonding. A Board of Trustees was appointed and organized, some of the bonds were put out, and $675,000 more are about to be issued. A suit was brought in the United States Circuit Court by James W. Fellows and others of the cities of New York, Brooklyn, and Chicago, all being taxpayers of the city of Toledo, against the city, its officers, and Natural Gas Trustees, alleging that the Act under which these bonds are proposed to be issued is unconstitutional, for a number of reasons. Those of chief interest are: That the Act authorizes the taking of private property for other than public use; that it impairs the obligation of contracts; and that it sanctions the mingling of municipal funds with those of other persons, and applies public money to private enterprise or purpose. The leading question is whether the supplying of natural gas is a "public use" within the meaning of the law. There can be no question that the taking by taxation of the property of a citizen is a taking of private property, and therefore can be taken for public use only. What constitutes a "public use?" If the furnishing of fuel be a public duty or use, municipalities may be permitted to borrow money, issue bonds therefor, and purchase coal lands, provide for the transportation and distribution of coal to the citizens, conduct a coal business (but without profit), and tax all other coal dealers to supply its deficiencies arising from failure to pay expenses otherwise. If it be a public use to provide fuel for heat in winter, why not ice to keep the people cool in summer? If it be a public use to supply the people with fuel, why not with clothing, shelter, and food? The broad question is presented whether a city has a right to provide agencies by taxation upon its inhabitants, including its merchants and business people, to provide consumers with the necessities or comforts of life at cost price, or for nothing if it pleases, crowd out of trade the business interests of all merchants and people making supplies, and tax them for the support of their successful competitor. The question involves a principle that grows the more it is reflected upon. It has been held in many States, that taxes cannot be imposed to aid persons suffering from a great fire or flood, by providing them with money, food, seed, or otherwise. If, under these conditions of disaster, public moneys cannot be applied to such uses, by what process of reasoning can individuals be entitled to like aid for fuel in the absence of disaster? But the citizens of Toledo are supplied with natural gas fuel through the agency of two companies already existing, and which have been in operation for three years. These companies were chartered by the same authority that assumes to sanction the issue of these bonds. They have been acting under ordinances passed by the same city which now proposes to issue the bonds for the purpose of depriving them of profits. These ordinances provide (*inter alia*) that the city may fix the maximum price at which natural gas shall be sold to the citizens; and it has acted on this authority. The companies are charging no more than the price fixed by the city itself. The charter and ordinances being a contract between the parties, is not this issue of bonds, and the setting up of a plant which will act as a confiscation of profits, at least a violation of that contract? If not, the property of no business corporation is safe in any municipality; the protection of business is broken down. The considerations involved are too extended to follow. They are merely introduced here to show that in this case the litigation is in good faith, that it is likely to be extended over a long period, and that it involves the first principle of value—the validity of the bonds themselves. Until the final decision of the Court of highest resort, it cannot be known whether the bonds issued by the city of Toledo under this Act have any validity or value.

North African Gas Syndicate, Limited.—The object of this Syndicate, which has been registered with a capital of £30,000, in £1 shares, is to carry on the business of a gas or electric light company in the towns of Algeria and other parts of Northern Africa.

Dynamite Explosion at the Thirlmere Works.—A shocking accident, which resulted in the death of two workmen, occurred last Friday week, in the Chapel Green Tunnel, near Grasmere, in connection with the Thirlmere Water-Works scheme of the Manchester Corporation. Henry Coward and William Ridley, both miners, were engaged charging a hole with gelatine dynamite, when the charge exploded, killing Ridley on the spot. A medical man was called, but could not do anything for Coward, who died on being removed to his home. Two other men, named Fred Walters and John Pearse, were employed in the same heading at the time charging another hole, but escaped unhurt, with the exception of a slight injury to one of Walters' legs. An inquest was opened by Mr. J. B. Wilson, the Coroner, on the following evening; and after evidence of identification had been taken, it was adjourned.

METROPOLIS WATER SUPPLY.

The Quality of the Water in November.

The returns furnished to the Registrar-General by the London Water Companies on the water supply of the Metropolis during the past month, show that the average daily supply was 164,599,821 gallons, being at the rate of 27·9 gallons per head of the population, as compared with 27·2 gallons per head in the corresponding month of last year. Of the entire bulk of water sent out, 83,644,525 gallons were drawn from the Thames, and 80,955,296 gallons from the Lea and other sources. Reporting upon the quality of the supply, Dr. E. Frankland said: "Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending December, 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies and by the Tottenham Local Board of Health, was: Kent, 0·8; New River, 0·9; Tottenham, 1·2; Colne Valley, 1·4; Lambeth, 2·7; Grand Junction, 2·8; Southwark, 3·2; West Middlesex, 3·3; East London, 3·5; and Chelsea, 4·0. The water drawn from the Thames by the Lambeth, Grand Junction, and Southwark Companies was of better quality than that delivered in the previous month; whilst the supply sent out by the Chelsea and West Middlesex Companies was inferior. All the waters were efficiently filtered before delivery. The water obtained chiefly from the River Lea by the New River Company was of high organic purity; whilst that drawn from the same source, but lower down the stream, by the East London Company, was of about the quality of the inferior Thames waters. Both waters were efficiently filtered. The deep-well waters of the Kent and Colne Valley Companies and of the Tottenham Local Board of Health were, as usual, of a high degree of organic purity; the Kent supply being especially distinguished in this respect. All the waters were clear and bright.

Messrs. Crookes, Odling, and Tidy, in the course of their report to the Official Water Examiner for the Metropolis (General A. de Courcy Scott), on the quality of the daily samples of water supplied in London last month, say: "The condition of the water supply to the Metropolis during the month of November continued satisfactory; but, with the coming on of winter, there was noticeable, as had been anticipated in a previous report, a slight increase in the small proportion of organic matter recorded as present in the water for now several months past. Thus the mean proportion of organic carbon in the water distributed by the five Companies taking their supply from the Thames, which amounted to 0·138 part in September, and to 0·143 part in October, was found to be 0·153 part in 100,000 parts of the water in November; with a maximum of 0·178 part in any single sample examined during the month. It is noticeable, moreover, that the mean proportions of organic carbon present in the New River and East London Companies' supplies, though below the actual mean present in the Thames-derived supply, exhibited a somewhat greater relative increase during the past month."

The Charge for Water in the City.

The Water Committee of the Corporation of London have recently been considering the great disproportion which exists between the water actually consumed by the owners and occupiers of premises exclusively used for business purposes, and the contributions required from them by the Water Companies, and the best way of mitigating this tax on trade. They lately held a conference with the Board of the New River Company, with the object of ascertaining whether any mutual arrangement could be adopted which would relieve the occupiers of business premises of a portion of the heavy charges for water to which they are subjected. They subsequently received a communication from the Company, stating that the Directors could not acquiesce in any proposal which might tend to injuriously affect the position of the concern; and that the due protection of the present income must be taken as an indispensable condition of any proposal which the Company could entertain. They further stated that the rates authorized by law constituted their return for onerous obligations undertaken and fulfilled by them, and such rates formed the security on which large sums of money had from time to time been invested in the undertaking by trustees and others looking for a permanent and unfluctuating income; and the interests of the proprietors the Company were bound to guard. On the general question raised, it was pointed out that the application of the principle of charging for water by a scale of percentage on the yearly value of the premises served, and not on the actual consumption, necessarily produced rates which, in some cases, were merely nominal, while in others the amount was undoubtedly substantial. But however low might be the amount in houses of small value, the Company had no option but to furnish the supply; and it would be impossible for them to attempt to increase the charge. They submitted that they were justly entitled to the higher rates produced by the operation of the same scale in premises of a superior class. With this reply before them, the Water Committee have thought it useless to proceed further in the matter. At the meeting of the Court of Common Council last Thursday week, the report of the Water Committee, of which the foregoing is an abstract, was presented, and the matter was referred to the General Purposes Committee. On the same occasion a resolution of the Ward of Farringdon Within was read, on the subject of the present basis on which the water-rate is assessed, and urging the Corporation to take immediate steps to apply to Parliament to secure such terms as may give ratepayers the option of being supplied by meter. The charge for water in the City was one of the principal topics at the ward-motes on the 21st inst.; and much dissatisfaction was expressed at the report presented by the Water Committee, of which the foregoing is an epitome. Hope was expressed that the labours of the General Purposes Committee will be more fruitful of results.

THE THIRLMERE WATER SCHEME OF THE MANCHESTER CORPORATION.

A Backward Contract.

A Special Meeting of the Manchester City Council was held on Monday last week—the Mayor (Mr. Alderman Mark) in the chair—to consider reports by the Engineer (Mr. G. H. Hill) and the Water Committee, on the position of the work undertaken by Mr. T. W. Chester under contract No. 4 of the Thirlmere aqueduct. The Engineer, in his report, averred that the work was not proceeding at a speed that was likely to complete it by the time agreed upon, and that the works were not being executed to his satisfaction. The total contract price named in the tender was £143,269, and the date therein fixed for the completion of the work was May 1, 1891; and there had been no special circumstances which, in his opinion, entitled the contractor to an extension of the time. He asserted that the contractor had from the first allowed the work to fall into arrear, more especially the cut-and-cover portion. From time to time he had remonstrated with him, and pressed upon him the necessity of proceeding with greater speed; but had failed to obtain adequate response to his remonstrances. The contract comprised a length of aqueduct of about 15½ miles. In the opinion of Mr. Hill if the contract were left in the hands of the present contractor, there was no chance of his completing it until the date fixed for completion had long passed; and he was further of opinion that this state of things arose from the default of the contractor and not from causes beyond his own control, or which he had not undertaken to meet, and that there were no causes to which this backward state of the works, and this unsatisfactory manner of executing them, were attributable, which operated as an excuse to the contractor. He considered it imperative that action should be taken under clause 225 of the specification. On the motion of Alderman Sir John Harwood, seconded by Alderman Reade, it was agreed to enter the report of the Engineer on the minutes. The report of the Water Committee was then read; and in it the Committee said that, having considered the report of the Engineer, and examined into the matters to which it related, they were of opinion that the statements therein were correct and the representation well-founded, and that it was desirable that a special meeting of the Council should forthwith be convened for the purpose of considering such representation, and deciding upon the action to be taken thereon. It was also agreed to enter the report on the minutes. Sir J. Harwood then moved the following resolution:—"That upon consideration of the representation of Mr. G. H. Hill, made by him to the Council by a report dated the 10th of December, 1889, relative to the contract No. 4 of the Thirlmere aqueduct, under which contract he is the Engineer, it appears to the Council that Thomas William Chester, the contractor under such contract is not proceeding with the work of such contract at a speed that is likely to complete it by the time agreed upon, and that the works under such contract are not being executed to the satisfaction of the said Engineer, and that such delay and non-performance of the said contract are due to the default of the said contractor." Sir John said there was no doubt when a contractor had entered into an arrangement to do for the Corporation for a sum of upwards of £100,000 a piece of very important work in a large undertaking, it was a serious step to interrupt that work whilst it was being carried on; and nothing short of a very grave sense of responsibility would justify the Committee in coming to the conclusion, after careful consideration of the Engineer's report, that they had no other course left than that proposed. Mr. B. T. Leech seconded the motion, which was unanimously carried. Sir J. Harwood next proposed—"That the Corporation do forthwith put into force the provisions of clause 225 of the specification annexed to and forming part of the contract No. 4, referred to in the preceding resolution, and give notice to the contractor, in conformity with such provisions, of their intention at the expiry of seven days from the giving of such notice to take the whole of the works under such contract into their own hands, and to seize and take possession of all the implements, horses, materials, and plant provided by the contractor, as and for the purposes set forth in the said clause; that the Deputy-Town Clerk do further draw up a notice to the above effect, and that, under the direction of the Mayor, the seal of the Corporation be affixed thereto, and that the same be thereupen served upon the contractor Thomas William Chester, or one of his overlookers; that Mr. George Henry Hill be appointed, under the corporate seal, agent on behalf of the Corporation, subject, nevertheless, to revocation at their pleasure, to take possession of the said works under, and in accordance with, the said notice, at the expiry of the seven days mentioned therein, and in like manner to seize and take possession of all the implements, horses, materials, and plant provided by the said contractor, and to do all things requisite and necessary in that behalf to carry into effect the provisions of clause 225 of the said specification, and to hold possession of the said works, implements, horses, materials, and plant, and for the above purposes to appoint bailiffs, inspectors or servants under him to take and hold possession as aforesaid on behalf of the Corporation." This motion was also seconded by Mr. Leech, and unanimously agreed to. The proceedings then terminated.

LEICESTER CORPORATION WATER SUPPLY.

The Application to Parliament for Additional Powers.

A Special Meeting of the Leicester Town Council was held on the 16th inst., to consider and determine as to whether or not the Corporation should proceed to Parliament in the ensuing session for power to acquire land and construct a new reservoir to supplement the water supply of the borough. In moving the formal resolution to the effect that the Council should make application, Alderman Wood gave some interesting particulars regarding the present position of the water undertaking, the cost of the proposed scheme, and the financial prospects of the department. He said he thought the necessity for a further water supply was apparent to everyone. Their storeage at the two existing reservoirs was sufficient to supply something like 200,000 people. At Thornton the storeage capacity was 330 million gallons; and at Bradgate they could store 556 million gallons. The proposed Swithland scheme would provide storeage accommodation for a further 530 million gallons; so that it would augment the supply by something like two-thirds. In order that they might rightly estimate the importance of the step they were about to take, it would be well to consider the present demands. The water consuming population was about 178,000, in addition to which they were liable to be called upon to supply other districts with a population of 14,400. The Water Committee that day had had to sanction the laying of pipes to supply another district, with a population of 4000; so that their actual consuming population would soon be 182,000. When they considered the fact that, when the reservoirs were full, they had only water enough to supply 200,000, the urgency of the measure would be apparent, especially remembering the rapid growth of population. The population had been growing for some years past at the rate of rather more than 3 per cent.; but the demand for water had been increasing at the rate of a little over 5 per cent. Their Engineers had carefully compiled figures which showed that, even if this scheme was adopted, in 14 or 15 years time—in 1904—the supply would again be exhausted; and within four or five years of that date the Council would have to seek a further source of supply. The cost of the new works, it was estimated, would be about £238,000; and besides this, there would be a necessity for some additional outlay at Bradgate for engines and filtration purposes, amounting to about £32,000—making the total involved in the new scheme £270,000. They would also have to ask parliamentary sanction for some capital to enable them to extend their mains as demands might be made upon them; and the Committee recommended that a sum of £50,000 be asked for in the Bill. Of course, in contemplating a large outlay of this kind, they naturally first of all thought of the strain it might make upon their present profits. As they were aware, these profits had now reached something like £10,000 a year. They expected, by the increase which was taking place in the population supplied, that the net revenue would be augmented every year by £2000. This had been their past experience; and they had a right to presume that it would be the experience of the future. The extra £2000 would, in the first instance, be applicable for the interest upon the outlay as it was made from time to time. Mr. Coleman seconded the motion, which, after a brief discussion, was unanimously carried. The statutory meeting of owners and ratepayers has also been held, and their consent obtained to the promotion of the Bill.

The revenue account of the Reading Corporation Water Department for the half year ending Lady-day shows a balance of surplus profits of £1610.

DUNDEE CORPORATION WATER SUPPLY.

COMPARATIVE COST OF THE LINTRATHEN WATER-MAINS.

The economic value of foresight is being realized by the Dundee Water Commissioners in connection with their duplicate water-main from Lintrathen Loch. The work was completed about a year ago, and has been such an unqualified success that the Commission recently resolved to grant the contractors (Messrs. D. Y. Stewart and Co., of Glasgow) a certificate to the effect that they had performed their contract thoroughly satisfactorily. Mr. J. Watson, M. Inst. C.E., the Engineer to the Commission, has lately made out a statement showing the comparison between the cost of construction and maintenance of the two mains. From this it appears that the pipes for the first main, which were laid in 1874, cost £72,545; and those for the new main, £33,200—a saving of £39,345. This was effected by the reduced cost of iron; the price per ton in 1874 being £8 1s. 3d. for straight pipes, and £14 10s. for special castings, against £3 13s. 4d. and £8 7s. 6d. respectively for the new main. The contracts for the tracks, bridges, tunnels, valves, &c., were £23,800 in 1874 and £10,960 in 1888, or £12,840 less. Miscellaneous matters—such as compensation to farmers, engineering, inspection, and law expenses cost—£10,855 in 1874 and £3732 in 1888—a difference of £7123. The total charges were £107,200 in 1874, and £47,892 in 1888; showing a saving to the Commissioners of £59,308, or 124 per cent. This sum, at 5 per cent. interest, represents nearly £3000 per annum in favour of the second main. Up till now, too, the recent works, though so much cheaper than the others, have not cost anything for repairs or maintenance; whereas the first main, in the same time, entailed an outlay of more than £1000. These facts, Mr. Watson considers, sufficiently attest the wisdom of the Commissioners in entering into the last contract when they did, as if the works had to be carried out now, they could not, at present rates and prices (which are not deemed excessive), have been completed for less than £66,000, or nearly £18,000 more than they actually cost. He does not expect they will ever again obtain cast iron at £3 13s. 4d. per ton; but he is of opinion that, in the not distant future, cast iron will give way to its better and more reliable rival, steel. The foregoing is a splendid record, and shows that the Commissioners did right two years ago when they accepted Mr. Watson's advice to proceed with the new main at once.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 28.

Sulphate of Ammonia.—A holiday feeling prevails; and very little business is passing. Buyers are still found for the parcels offering; although in some cases a slight reduction has been accepted. A fair quantity is offering for early January delivery; but as it may be anticipated that there will be an improved demand at the beginning of the New Year, prices will probably retain their position. Quotations meanwhile are £12 5s. to £12 6s. 3d. f.o.b. Hull. Leith and Liverpool parcels may possibly be secured at a trifle less. Nitrate is inactive at 8s. 4½d. to 8s. 6d.

LONDON, *Dec.* 27.

Tar Products.—Very little new business has been reported during the week. Most products maintain their improved values, and continue in fairly good demand. Common oils, free from salts, are in great request for lamp purposes; while the heavier oils are dull. Anthracene is quoted firm, but no business doing. A large make of benzole is being taken up, and prices are decidedly inclined to improve. Prices:—Tar, 25s. to 30s. per ton, according to position. Benzole, 90 per cent., 3s. 4½d. per gallon; 50 per cent., 2s. 7½d. per gallon. Toluol, 1s. 7d. per gallon. Solvent naphtha, 1s. 8d. per gallon. Pitch, 30s. to 35s. per ton. Crude naphtha, 1s. 3d. per gallon. Light oil, 4½d. per gallon. Creosote, 2½d. per gallon. Carbolic acid, 3s. 4½d. per gallon. Cresylic acid, 10d. per gallon. Anthracene (30 per cent.), nominal "A" quality, 1s. 3d. per unit; "B" quality, 1s. 1d. per unit.

Ammonia Products.—Sulphate is firm, and makers are well sold. Stocks are low, and heavy shipments continue to be made to the Continent, at prices ranging from £12 2s. 6d. to £12 7s. 6d. Other ammonia products continue as before.

THE MINERALS UNDER THE DONCASTER CORPORATION WATER RESERVOIR.—Messrs. Charlesworth, of the Thrybergh Hall Colliery, have intimated to the Doncaster Corporation that they are approaching their water reservoir at Ravenfield with their mineral workings. It is an open question for the Corporation whether or not they will purchase the minerals.

THE ACCIDENT AT THE SALTLEY GAS-WORKS.—Up to last Saturday sums amounting to £215 17s. 10d. had been received at the offices of the *Birmingham Post* on behalf of the widows and families of the men, Case and Chew, who lost their lives in gallantly rescuing one of their comrades, on the 11th inst., from the gasholder which was under repair at the Saltley works of the Birmingham Corporation.

A RELIEVING OFFICER AND THE STRIKE AT THE SOUTH METROPOLITAN GAS-WORKS.—The *agenda* before the Cambridge Board of Guardians, at their meeting last Wednesday week, contained very little business, and so the members spent a good deal of time in a fruitless discussion on a letter which had been received from the President of the Building Trades Debating Society, on behalf of the representatives of the principal Societies connected with labour, and who were also ratepayers of the borough. The letter complained that "our servant, Alfred Worthy, Relieving Officer for our Union," had been utilizing his time in procuring employment for men who had never received, nor asked for relief, some of whom were not residents within the area of the Union, for the purpose of supplying men to fill the places of those now on strike at the South Metropolitan Gas-Works. They alleged that, by this action, he had interfered with their rights as working men, in aiding a large monopoly to "oppress" their fellow workmen, and cause pauperism and poverty in their midst; and they prayed that the Guardians would fully inquire into the matter. Mr. Bullock opened the discussion by making an inquiry of Mr. Worthy of which he had given notice—whether or not it was his duty to act as "recruiting-sergeant" for the Gas Company in the strike now pending? Mr. Worthy was prepared with a written reply, in which he stated that he was not requested by the South Metropolitan Company to initiate action in this matter. On the 7th inst. he saw an advertisement offering work on advantageous terms to labourers. He at once carried out what had been his invariable practice; and for doing which successfully, he had many times received the commendation of the Board. He became the medium of communication between those who were seeking work and those who wanted labourers. This effected, they were left entirely free to make their own bargain, and consigned themselves to London. He denied that he was a "recruiting-sergeant" for any person or body of persons. After a good deal of small talk, the Chairman (Mr. E. C. Young) summed up the matter by saying "that Mr. Worthy had let his zeal outrun his discretion, and he might be a little more careful in the future." This was the general opinion of the members; but they did not give any formal expression to it.

NOTES FROM SCOTLAND.

(FROM OUR EDINBURGH CORRESPONDENT.)

EDINBURGH, *Saturday.*

Mr. Hay, the Town Clerk of Dundee, is a sensible man. At a meeting of the Law Committee of the Town Council on Thursday, he put the matter of the electric lighting of part of the city before the members in a way which should open the eyes of some of the devotees of "progress" on the Board. For instance, reporting in the interests of the general community, he told them that the electric light is not a necessary of life, that the town is well supplied by gas light, and that at present it appears to him that the electric light is practically an experiment. He does not think there should be compulsory power to force the use of the light on the ratepayers, or to make the property of the town generally pay for the new supply, which, if successful, would only supersede the present gas supply, against which there is no complaint; that the proposed area is limited, and leaves out most of the large establishments, which are likely to be supplied by their owners if the light should be successful, but which, as he understands, would be subjected to their share of the loss in the event of its proving a failure. He considers that the opinion of the ratepayers should be ascertained before deciding to proceed with the electric lighting proposals; and that if they agree, the body to be entrusted with the scheme should be a board directly representative of, and responsible to the ratepayers. His feeling is that it might be the safest and best way for that body to endeavour to arrange with some of the electric lighting companies to supply the light for a short time, on reasonable terms, which would avoid the risk of laying down heavy plant at great cost, for which the public might be chargeable. The Commissioners of Police, he believes, would be a fairly representative body to be entrusted with the electric lighting power, and not the Town Council, Police Commission, and Gas Commission jointly. This trenchant report produced an animated discussion, and has already had the effect of extorting a promise from the Lord Provost that the Joint Committee will be called together to consider which body should have the control; and a Committee was elected to look after the interests of the Town Council. There is, therefore, a prospect that, through Mr. Hay's action, the community will not be "rushed" into a heavy liability for electric lighting plant, without first determining who is to "pay the piper" when the bills come in.

The inhabitants of Stenhousemuir, a populous place beside Falkirk, in which there is as yet no corporate authority, have taken what is frequently the first step towards the establishment of municipal government, in a voluntary effort to light their streets by gaslight. Funds have been raised by subscriptions for the purpose; and this week the contracts for the work were let, and a Committee appointed to look after the maintenance of the lighting plant. This is not a very satisfactory method, because those who will not pay cannot be compelled; but seeing that out of it there is likely to grow a movement for the adoption of the Police Act, the present can only be regarded as a step in the right direction.

Lord Lee, in the Bill Chamber of the Court of Session yesterday, had before him two applications by the Lord Provost, Magistrates, and Town Council of Glasgow, as Water Commissioners, for interdict against the Blanefield Printing Company, of Glasgow, and John Coubrough, of Blanefield, in connection with the acquiring of land for the extension of their water-works. The Blanefield Printing Company own 8 acres 31 poles of ground in the parish of Strathblane, upon which is their Dumbrock Bleach Works, and the Water Commissioners have notified them of their intention to acquire a small strip, 11 yards wide and 125 yards long, containing 1 rood 6·41 poles, for their new aqueduct. Coubrough is owner of a cottage in Strathblane; and the Commissioners desire to take a small portion of the property, extending to 28 poles. These proprietors do not wish to part with a portion of their subjects; but under clause 90 of the Lands Clauses Act, they require the Water Commissioners to take the whole, and to enforce their view they have appointed arbitrators to fix the price. The Company ask £7000 for their property; and Mr. Coubrough, £1400 for his. The view of the proprietors is that, as they purchased their properties as one concern, it is incompetent to compulsorily take only a portion of them. The Company say they would not have given the high price they did for the factory unless there had been a large piece of vacant ground attached to it, upon which to extend their works, and that the strip required by the Commissioners will be needed for the efficient working of the factory when it is in operation. The Commissioners, on the narrative that they are about to have the question determined in the Law Courts, seek to have the arbitration interdicted in both cases. Lord Lee granted interim interdict.

The reservoir from which the Oban water supply is derived is leaking at the rate of 50,000 gallons per day, supposed by the engineers to be due to a fissure below the puddle trench of a new embankment. Remedial works failed to catch it; and, as a last resort, it has been resolved, on the advice of the engineers, to allow the leak to go on, but to intercept the escaping water, and divert it into the measuring basin. This work is to be proceeded with, and the water will not be lost; but what will the condition be of the embankment, as regards safety, with a continuous leak of such dimensions going on under it?

(FROM OUR GLASGOW CORRESPONDENT.)

GLASGOW, *Saturday.*

The demand for Glasgow gas still goes on increasing, notwithstanding the numerous examples of the adoption of electric lighting in business premises, railway stations, public halls, private houses, &c. During last month the make of gas at the three works belonging to the Glasgow Corporation Gas Commissioners amounted to 385,279,000 cubic feet, as compared with 366,781,000 feet in the corresponding month of last year. These figures show an increase of 18,498,000 feet of gas for November, or about 5·04 per cent. Such a large and steady increase in the consumption is highly satisfactory. Another highly satisfactory fact is the almost entire absence of thick fogs this winter up to the present date. Hitherto the largest 24-hour consumption of gas was that of last Tuesday—the day before Christmas Day, when it amounted to 16,566,000 cubic feet. On the preceding day, it amounted to 16,163,000 feet; while on the 19th and 20th inst., it reached to 16,522,000 and 16,452,000 feet respectively. On Dec. 19 last year, however, it amounted to 16,811,000 feet, which is the biggest day's consumption yet recorded in Glasgow—a quantity that does not seem likely to be reached this winter, unless a very heavy fog overtakes this part of the Valley of the Clyde. The largest number of retorts yet working at any one time at the three works this winter has been 1718, which are now in actual operation. Many of these retorts are much above the average size.

On Thursday of this week the monthly meeting of the Glasgow Corporation Gas Committee was held, on which occasion there were under consideration a number of draft Provisional Orders, all of which had reference to powers that are being sought under the Electric Lighting Acts of 1882 and 1888, and one Parliamentary Bill in which special powers are asked by the Partick, Hillhead, and Maryhill Gas Company, Limited. Prints of these various measures had been furnished to the Town Clerk.

After the Committee had carefully deliberated on these measures, it was resolved that all the Provisional Orders and the Bill of the Partick Gas Company should be opposed, and that opposition should likewise be given to all the other Provisional Orders in respect of any prospective interference by them of the rights and powers already possessed by the Glasgow Corporation or the Gas Commissioners, or of interference with fresh powers being sought for by the Corporation in the ensuing session of Parliament. In addition to the Gas Company mentioned, Provisional Orders are being promoted (1) by Messrs. Muir, Mavor, and Coulson, Limited, who are the proprietors of the only central electric lighting stations in Scotland, and who supply current to the General Post Office, the new Corporation Buildings, and many business premises; (2) the Scottish House-to-House Electric Lighting Company; (3) the Brush Electric Light and Power Company; and (4) the Kelvinside Electricity Company, whose proposed area of operations is that of Kelvinside, which is outside of Glasgow proper, and is bounded in great part by the suburban burghs of Partick, Hillhead, and Maryhill. The other two Companies propose to cover all the burghs immediately surrounding Glasgow, both north and south of the Clyde. I rather think that Messrs. Muir, Mavor, and Coulson intend to confine their operations to Glasgow proper. The Gas Committee authorized their Special Sub-Committee on Electric Lighting to take charge of the opposition in Parliament, acting in conjunction with the Parliamentary Bills Committee. It would almost seem as if there were at least one big fight to take place at St. Stephens in the course of the ensuing session.

At the same meeting of the Glasgow Corporation Gas Committee, Mr. W. Foulis, the Engineer, submitted a report on the interference with the gas-mains that would be made by the forthcoming operations for the construction of the Glasgow Central (Underground) Railway in the thoroughfares underneath which it will eventually pass. He reported that in many places the arch of the tunnel would come so near the street surface that it would be very unsafe, if not quite impracticable, to relay the pipes in the same thoroughfares; and his recommendation was that he should have authority to divert the main supply pipes into other streets. His estimate of the probable expense of the diversion of the mains and other necessary operations was about £18,000. Mr. Foulis's recommendations were approved of. It may be remembered that the estimate of Mr. Gale, Engineer to the Corporation Water Commissioners, for the operations involved in connection with the water supply from the same cause was about £21,000. As is provided by the Act of Parliament, the Central Railway Company will have to bear this expense for lifting, diverting, and relaying all gas and water mains that will be disturbed by the railway operations.

A very graceful and commendable act was done by the Glasgow Gas Committee at last Thursday's meeting. Mr. John Bowers, whose duty it is to take charge of the gas and water affairs on behalf of the Town Clerk, has lately completed for that gentleman, and under the authority of the Gas Committee, a very comprehensive volume, containing all the Acts which have been obtained by the Corporation relative to the gas undertaking, arranged in chronological order, and numerous notes which have been added to assist in connecting the provisions applicable to each matter. There is also an appendix containing the General Public and Local Acts incorporated with the Glasgow Corporation Gas Acts, or the provisions of which are applicable to the gas-supply undertaking, together with various other official documents connected with the same undertaking. For his valuable services in connection with this piece of legal and literary work, Mr. Bowers was awarded a "Christmas Box" in the shape of a bank cheque for fifty guineas.

Only a small amount of business has been done in the Glasgow pig-iron market this week, chiefly owing to excitement consequent upon the issue of the annual returns regarding the stocks of pig iron, the make during the year, the consumption, shipments, &c. These returns were issued with official authority in the course of Tuesday. They showed that there had been during the year a decrease in the stocks of Scotch iron to the extent of 208,593 tons, which is certainly a very favourable result; but as it is in a great measure something like what was anticipated, the returns have not had much effect on the market. Business was suspended at noon on Tuesday for the holidays, and was not resumed till yesterday. Scotch warrants changed hands on Monday at 61s. 4½d. per ton; and yesterday afternoon there were sellers at the close at 62s. 6d. per ton—being an advance of 1s. per ton from Tuesday's close. Yesterday the price of hematite pig iron advanced 2s. per ton, to 76s. 7½d. Cleveland iron is somewhat depressed, and its price is 9d. per ton under Scotch iron.

Business in the local coal trade has been exceedingly good during the past week, alike in the shipping and other departments. Main coal has firmed up in price to 9s. 6d. per ton f.o.b. at Glasgow Harbour, and all coal is quoted at 10s. per ton. Splint is also in good demand, and all qualities of steam coal have been in fully better request. Furnace sorts maintain a very steady position in the market; and notwithstanding the mildness of the season, house coal is not by any means plentiful. The year is closing with a very healthy tone all round; and a hardness in quotations, which augurs well for a steady continuance of the trade into the greater portion of next year.

Torquay Water Supply.—At the last meeting of the Torquay Local Board, Mr. T. S. Weeks, Superintendent of the water-works, reported that the third section of the duplicate main, from Jew's Bridge to Knowles Hill, a distance of 5600 yards, had been completed. The increase to the point of delivery was at the rate of 155 gallons per minute, or 223,200 gallons per day. At the Warberry reservoir the increase was 87 gallons per minute, or 125,280 gallons per day. Calculating for twelve hours' delivery into each reservoir, the available additional daily supply would be 174,240 gallons; or rather more than four gallons per head for the 43,000 persons supplied from these works. The works had cost, including compensation, £5795; being £475 less than the estimate. Of this, £374 was on the iron pipes; the tender being 7s. 6d. per ton below the estimate. General satisfaction was expressed at the way in which Mr. Weeks had performed his task.

The Northern Coal Trade.—There has been during the past few days the usual holiday interruption in the coal trade. Northumbrian steam coal has been fairly steady, and the price for the next few months is very well maintained, when it is borne in mind that this is the season usually of the lowest demand. The price quoted for best steam coal is about 11s. 6d. per ton free on board in the Tyne, which is some 2s. above that asked a year ago. The inquiry for gas coal is very strong; and there is not likely to be any diminution for some time, though the period of the largest local demand is now passed. It is very difficult to quote prices for gas coal, as they vary from 13s. to 15s. per ton, free on board. The house coal trade is very dull; the mild season keeping back the demand. For ship and manufacturing coal, there is a good inquiry. It seems to be expected that throughout the largest part of 1890 there will be a comparatively high range of prices for coal; and it is certain that there will be paid on gas coal some 50 per cent. more for contracted coal than has been paid during the year that has now closed.

The Price of Coke.—We understand, said the *Birmingham Gazette* last Saturday week, that there is a probability of the price of coke being advanced in a few days. Although no definite information has been obtained, rumours were prevalent in Birmingham yesterday on the subject; and it was stated that the Durham and other large producers have decided with the new year to put up their prices 6s. per ton. Should this decision be arrived at, it will unquestionably have a marked influence upon the makers of marked iron in revising the prices to be declared at the approaching quarterly meetings; and instead of an additional 10s. being quoted, the present prices will most likely be lifted up £1 a ton.

Addingham and the Bradford Water Scheme.—The inhabitants of the village of Addingham have, in public meeting assembled, passed the following concise resolution:—"That this meeting of the ratepayers of the township of Addingham dissent to the Bradford Corporation water scheme." It appears that by their Act of 1848, the Bradford Corporation were empowered to take water which formerly ran through the village, allowing a very small quantity to run down the streams; and it is considered that the present proposals of the Corporation will further curtail the quantity of water in the streams. Another grievance is that the Addingham Water Company purchase water from the Bradford Corporation, paying at the rate of 1s. per 1000 gallons, whilst to large consumers in the borough the charge is considerably less. A Committee was elected at the meeting "to carry out the resolution;" and it is intended to oppose the Bill of the Corporation in Parliament.

The Wakefield Corporation's New Reservoir and the Underlying Coal.—At a special meeting of the Wakefield City Council last Tuesday, it was reported that Mr. J. Wordsworth, of Newmillerdam, had made a claim against the Corporation in respect of four seams of coal belonging to him, and underlying the reservoir recently constructed in connection with the new water-works at Ardsley. An agreement had been come to between the Water Committee and Mr. Wordsworth for the purchase of that gentleman's interest in the coal, and had been signed by the solicitors on both sides. The terms were that the Corporation should pay Mr. Wordsworth £3200, with £100 for all costs; the original claim being £3600 for one bed of coal, and £800 for interest. On the motion of Mr. Fernandez, the Chairman of the Committee, seconded by Mr. Milnes, the resolution was unanimously adopted. It was stated that Messrs. Holliday paid £300 per year to Mr. Wordsworth for the right to work any or all of the four seams of coal underlying the reservoir.

Pontefract New Water-Works.—The sinking operations at Roall near Whitley Bridge, in connection with the new water supply scheme for Pontefract and district have been recently much retarded, owing to an extensive subsidence, and consequent inrush of sand and water into the well. The well had been sunk to a depth of 107 feet, and was proceeding most satisfactorily when the workmen struck into a hole on the east side of the well, and a cavity in the red sandstone of about 4 ft. 6 in. in width was then discovered. This cavity was soon filled with sand and water, which rose in the well to a height of 30 feet, and the sinkers had to make a hurried retreat. The fissure extends a distance of about 40 yards, and then appears on the surface. About 200 large bags filled with a concrete of sand and Portland cement were thrown into the fissures, along with a quantity of timber. In this way the flow of sand and water into the well was arrested, but not before hundreds of tons of sand had to be removed to the surface. The old wells at Pontefract are gradually diminishing in their yield of water; and a private well and engine are being resorted to for supplying the lower part of the town.

The Proposed Purchase of the Warrington Water-Works by the Corporation.—A special meeting of the Warrington Town Council was held on the 19th inst., for the purpose of considering the provisions of the Bill of which notice has been given for the extension of the borough and other matters. In one portion of the Bill it is proposed to authorize the purchase by the Corporation of the undertaking of the Warrington Water Company. The Mayor (Alderman Francomb), in explaining the provisions of the measure, said the subject of the purchase of the water-works had been before the Council for the last ten years. It was generally admitted that such supplies of a public nature as gas and water ought to be in the hands of the local authority; but they had been driven into attempting to acquire the water undertaking by the difficulty they had in obtaining satisfactory arrangements for the supply of water for Corporation purposes. He also thought that, if the undertaking were in their hands, they would be in a position to procure a greater quantity of water, which would induce manufacturers to come to the town, and thus enhance the rateable value of the borough. They had power to require the Corporation of Liverpool to supply them with 2 million gallons per day from Lake Vyrnwy. Sanction was given to the Bill.

Hints to the "Gassed."—Having read the evidence given at the Coroner's inquiry into the circumstances attending the deaths of the two men, Henry Tennick and Richmond French, which recently occurred at the works of the Leeds Forge Company, also Dr. Stevenson's report on the *post-mortem* examination, Mr. Fairfax Wooler, of Swinnow, near Leeds, has written a letter to a Yorkshire contemporary, in which he remarks: "Dr. Stevenson says that 'blast furnaces, forge furnaces, charcoal, water, or coal gas all throw off carbonic oxide, which is a non-supporter of life.' I have myself been 'gassed' under the following circumstances:—I was forge manager under the Farnley Iron Company at the time named by Prescott, and I had to superintend the erection of both the gas-producers (Siemens), and also the gas-furnaces. I have seen many of our men (gas makers) 'gassed,' especially new hands—in fact, we look for all new recruits to be affected more or less. On one particular night I told my cabman to be at the works at 9.30 o'clock. I went into the forge office at the appointed time, sat down in a half-backed chair, and took up the paper, waiting the arrival of the cab. At about 9.45 I felt a sudden pricking up my nostrils and between the eyes. This was my warning to get out quickly, which I did. But it was too late. I walked about 40 yards to the house of one of my under-managers; and while trying to get hold of the door-handle, lost all use of my legs, and fell in a lump in the corner. This caused the under-manager to open his door, and I told him I was 'gassed;' he at once got a bowl of cold tap-water, soaked a cloth in it, and put it on my head continuously, till the tears fairly streamed out of my eyes, when I obtained instant relief. Prescott is mistaken in saying we buried their heads in soil. We always kept wet clay at hand; but for some years back preferred a cold water cloth, as in my case. . . . The signs of a man being 'gassed' are a flow of water from his eyes, a tremor in his legs, or if more strong he staggers or actually falls. If any of these signs show up, the man must go away, and sit down—not walk about—in fresh air, and be very quiet; and when he comes round, which will not be long, he must go away home for that day, and he will be all right next morning. If he is 'gassed' outright, he should be laid gently down, and given half a tumbler of neat brandy; his head being bathed as in my case. All cabins, offices, &c., should be well ventilated on the floor line by grates; and in the morning waft the doors to and fro to move the gas on the floor."

A Novel Objection to Gas-Stoves.—A correspondent of a Wexford paper asks the Editor if he considers it fair for the Wexford Gas Company to put in gas stoves, and thereby do away with chimney sweeping!

Tarporley Water Supply.—The Tarporley Local Board having applied to the Local Government Board for sanction to borrow £2000 for works of water supply, a public inquiry has been recently held by Mr. T. Codrington, M. Inst. C.E. The Clerk to the Board (Mr. T. Cawley) gave evidence showing the necessity for a new water supply, which it is proposed to obtain from the Liverpool Corporation.

The Electric Lighting of Newcastle.—Arrangements have been arrived at between the Newcastle District Electric Lighting Company and the Newcastle Electric Supply Company for supplying electric light in Newcastle, and to carry out the same in such a way as not to interfere with the interests of each other. Both Companies are now actively engaged laying down mains to make up for the delay caused through the difficulty which recently arose as to the opening of the roads.

Failure of the Water Supply at Hoyland.—In consequence of the frequent failure of the supply of water at Hoyland Common, which is within the area of the Dearne Valley Water Company, the Local Government Board have been appealed to. In the memorial addressed to them by a local Committee, it was stated that the inhabitants had been without water for two or three days together, and on one occasion for seven days. The Local Government Board are in communication with the Company on the matter.

Dover Corporation Water Undertaking.—At a recent meeting of the Finance Committee of the Dover Town Council the estimates submitted for the coming year provided for a total expenditure by the Water Department of £3498; and it was computed that the water-rate would yield £3900. A letter was received from the Assessment Committee of the Board of Guardians, in which they said that they had decided to rate the water-works at £450. They had previously proposed to assess them at £2000. Several members thought the sum named now was fair; but the matter was referred to the Town Clerk for a report.

The Sewage Pollution of the Thames.—A Vestry meeting has been held at Weybridge to consider the notice which has been given of an intention to apply to Parliament next session for an Act to constitute a Joint Sewage Board for the districts of Staines, Chertsey, &c. The proposals of the promoters of the scheme were referred to in the Journal for the 17th inst. (p. 1171); but in the course of the Chairman's (Mr. H. Yool's) statement at this meeting, some figures relating to the cost of the project were given. From the estimates made by the Engineers (Mr. J. Mansergh and Mr. Birch), it appears that the expense of carrying out the main conduit will be in all £175,000. The main sewer will cost £110,000; works, £35,000; land, £7000; preparing land, £7000; to which has to be added 10 per cent. In addition to these amounts, there will, of course, be other expenses; so that the scheme, it is calculated, will involve an outlay of from £185,000 to £190,000. No formal resolution was passed in regard to the scheme; but it was resolved to adjourn the consideration of the subject until the Rural Sanitary Authority has obtained a report from an independent engineer.

Fatal Paraffin Lamp Accidents.—By the upsetting of oil-lamps in cottage houses in different parts of Manchester, early on Christmas morning, two women and a child have lost their lives. The first accident occurred shortly after midnight in the house of John Burgess, of Hulme. A paraffin lamp was knocked over, and Mrs. Burgess's clothes catching fire, she was so badly burned that it was necessary to at once remove her to the Manchester Infirmary, where she expired on Friday morning. The second and more serious case occurred about three o'clock the same morning, at the house of a man named Mulhall. Mrs. Mulhall was going upstairs with an oil-lamp in her hand, when the lamp fell, and the burning oil ignited her dress. She ran forward into a bedroom, in which were two of her children (a girl aged two, and a boy aged five), and there threw off some of her clothes. The mother and children were seriously burned, and were immediately conveyed to the Infirmary, where the unfortunate woman died in the afternoon, and her daughter on the following morning. The boy is expected to recover. Last Thursday week a small paraffin lamp was overturned at the house of a Mr. Coles at Woodside, Norwood, and his daughter, who was only 3½ years old, was so seriously injured that she succumbed the next morning.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see *ante*, p. 1242.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	10	17—18	+½	5 16 8
100,000	10	,,	7½	Do. 7 p. c.	10	12½—13½	..	5 11 1
800,000	100	1 July	5	Australian (Sydney) 5% Deb.	100	110—112	..	4 9 8
100,000	20	28 Nov.	8	Bahia, Limited	20	20—21	+½	7 12 4
200,000	5	14 Nov.	7½	Bombay, Limited	5	6½—7	..	5 7 1
40,000	5	,,	7½	Do. New	4	4½—5½	..	5 17 10
880,000	Stck.	14 Aug.	12½	Brentford Consolidated	100	218—223	..	5 9 10
125,000	,,	,,	9½	Do. New	100	158—163	..	5 15 6
220,000	20	12 Sept.	11	Brighton & Hove, Original	20	41—43	..	5 2 4
320,000	20	27 Sept.	11½	British	20	43—45	..	5 0 0
50,000	10	12 Sept.	11	Bromley, Ordinary 10 p. c.	10	19—21	..	5 4 9
89,000	10	,,	8	Do. 7 p. c.	10	13—15	..	5 6 8
328,750	10	14 Nov.	10	Buenos Ayres (New) Limited	10	13—14	+½	7 2 10
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	107—110	..	5 9 1
150,000	20	14 Aug.	8	Cagliari, Limited	20	25—27	..	5 18 4
550,000	Stck.	16 Oct.	18½	Commercial, Old Stock	100	242—247	..	5 11 4
180,000	,,	,,	10½	Do. New do.	100	195—200	+1	5 7 6
130,000	,,	28 June	4½	Do. 4½ p. c. Deb. do.	100	119—124	..	3 12 7
557,320	20	12 Dec.	18	Continental Union, Limited	20	47—48	..	5 8 4
242,680	20	,,	18	Do. New '69 & '72	14	33—34	..	5 6 7
200,000	20	,,	10	Do. 7 p. c. Pref.	20	36—38	..	5 5 3
75,000	Stck.	27 Sept.	10	Crystal Palace District	100	200—205	..	4 17 7
234,060	10	26 July	13	European, Limited	10	22—24	..	5 8 4
120,000	10	,,	18	Do. New.	7½	17—18	..	5 8 4
354,060	10	,,	13	Do. do.	5	11—12	..	5 8 4
5,470,040	Stck.	14 Aug.	13½	Gaslight & Coke, A, Ordinary	100	245—250	−3	5 10 0
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	100—105	..	3 16 3
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	250—255	..	3 18 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	123—128	..	3 18 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	182—187	..	4 0 4
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	157—162	..	4 6 5
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	248—253	..	3 19 0
1,051,150	,,	12 Dec.	4	Do. 4 p. c. Deb. Stk.	100	112—115	..	3 9 7
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	121—125	+1½	3 12 4
650,000	,,	,,	6	Do. 6 p. c. do.	100	160—170	..	3 10 7
3,800,000	Stck.	14 Nov.	12	Imperial Continental	100	213—218	..	5 10 1
75,000	5	12 Dec.	6	Malta & Mediterranean, Ltd	5	5—5½	..	5 9 1
560,000	100	1 Oct.	5	Met. of Melbourne, 5 p.c. Deb.	100	113—115	..	4 6 11
541,920	20	28 Nov.	6	Monte Video, Limited	20	18½—19½	..	6 3 1
150,000	5	28 Nov.	10	Oriental, Limited	5	8½—9	..	5 11 1
60,000	5	27 Sept.	7	Ottoman, Limited	5	5½—6½	..	5 13 0
166,870	10	26 July	4	Pará, Limited	10	3½—4½	−½	8 17 9
420,000	100	2 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds.	100	100—105	..	5 14 3
500,000	100	2 Dec.	6	2nd Do.	100	95—100	..	6 0 0
100,000	10	16 Oct.	10	San Paulo, Limited	10	14½—15½	..	6 9 2
500,000	Stck.	29 Aug.	16½	South Metropolitan, A Stock	100	295—305	..	5 6 6
1,850,000	,,	,,	12½	Do. B do.	100	229—234	−1	5 8 7
141,500	,,	,,	13½	Do. C do.	100	240—250	..	5 6 0
600,000	,,	28 June	5	Do. 5 p. c. Deb. Stk.	100	138—142	..	3 10 5
60,000	5	12 Sept.	11½	Tottenham & Edm'ntn, Orig.	5	11—13	..	4 8 5
				WATER COMPANIES.				
728,446	Stck.	14 June	9½	Chelsea, Ordinary	100	265—270	..	3 10 4
1,720,580	Stck.	16 Oct.	7½	East London, Ordinary	100	211—215	..	3 9 9
544,440	,,	28 June	4½	Do. 4½ p. c. Deb. Stk.	100	143—146	..	3 1 7
700,000	50	12 Dec.	9	Grand Junction	50	125—130	..	3 9 3
708,000	Stck.	29 Aug.	10½	Kent	100	276—281	..	3 14 9
1,043,800	100	28 June	9½†	Lambeth, 10 p. c. max.	100	256—261	..	3 12 9
406,200	100	,,	7½	Do. 7½ p. c. max.	100	200—205	..	3 13 2
200,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	100	120—124	..	3 4 6
500,000	100	14 Aug.	12½	New River, New Shares	100	364—369	..	3 5 8
1,000,000	Stck.	26 July	4	Do. 4 p. c. Deb. Stk.	100	127—130	..	3 1 6
902,300	Stck.	12 Dec.	6	S'thwk & V'xhall, 10 p.c. max.	100	167—172	..	3 9 9
1,126,500	100	,,	6	Do. 7½ p. c. do.	100	163—168	..	3 11 5
155,066	Stck.	12 Dec.	10	West Middlesex	100	260—265	..	3 15 6

† Next dividend will be at this rate.

GWYNNE & CO., ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C.

GWYNNE & BEALE'S PATENT GAS EXHAUSTERS & ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 2698.

Exhausters of nearly all sizes in Stock.

Prize Medals at all the Great International Exhibitions.

Exhausters equal to a total capacity of more than 26,000,000 cubic feet passed per hour have been supplied by us.

Our new Patent Non-Fluctuating Exhausters, to work without the slightest oscillation or variation in pressure, are strongly recommended.

MAKERS OF EVERY DESCRIPTION OF HYDRAULIC AND GAS MACHINERY.

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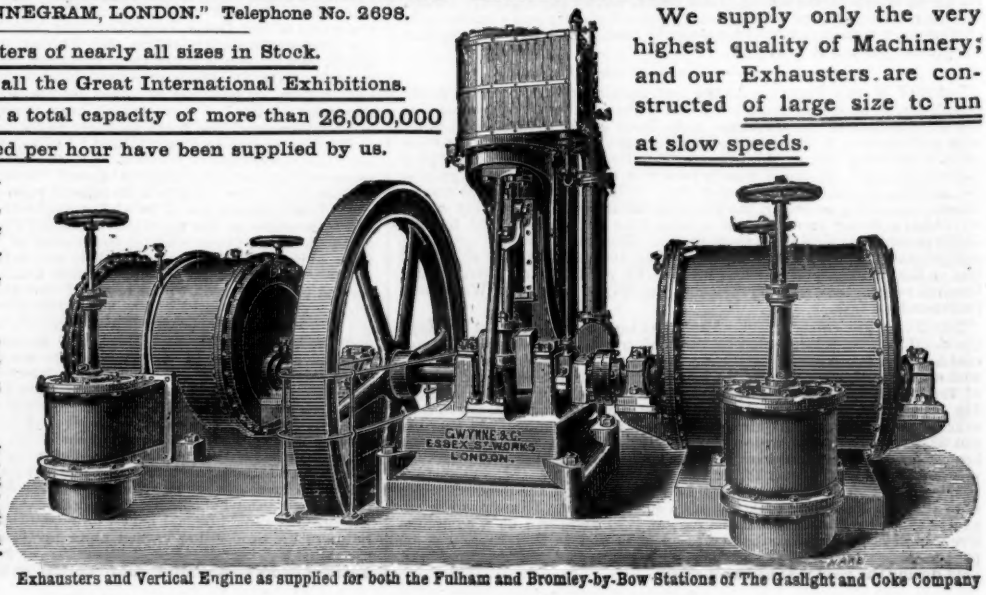

Exhausters and Vertical Engine as supplied for both the Fulham and Bromley-by-Bow Stations of The Gaslight and Coke Company

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

ANDREW STEPHENSON, Agent for the GAS PURIFICATION AND CHEMICAL COMPANY, Limited, Palmerston Buildings, Old Broad Street, LONDON, E.C.

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JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, No. 54, BERNARD STREET, LEITH, } SCOTLAND.

HUTCHINSON BROTHERS, Barnsley,
Gas Engineers and Contractors, Makers of Wet and Dry Gas-Meters and General Gas Apparatus, Sulphate of Ammonia Plant, Lead Saturators, Tanks, &c., Tools and Sundries.

BOROUGH OF MIDDLESBROUGH.

WANTED, an Experienced Engineer and MANAGER to take charge of the Gas-Works. He must have a thorough scientific and practical knowledge of the Manufacture and Distribution of Gas, and the Manufacture of Sulphate of Ammonia. He must also understand Regenerative Heating, and possess a practical acquaintance with Main and Service Laying. He must be competent to design and prepare plans for, and carry out all constructive works and alterations that may be required. His whole time must be devoted to the duties of his Office. He must not be under 25, nor more than 45 years of age.
The Office will be held subject to Three months' notice on either side.
The make of Gas is about 300 million feet per annum.
Applications, stating age, qualifications, present employment, and amount of salary required, together with not more than three recent testimonials, must be sent to the undersigned not later than the 22nd of January, 1890, endorsed "Gas Manager."
Any applicant canvassing will be disqualified.
GEORGE BAINBRIDGE, Town Clerk.
Municipal Buildings, Middlesbrough, Dec. 24, 1889.

TIMMIS & CO., of STOURBRIDGE
Make only the best quality of FIRE-CLAY RETORTS, BRICKS, TILES, & LUMPS. Also SPECIAL SILICA BRICKS, to stand great heats. All descriptions kept in Stock.
For Prices apply to JAMES LAWRIE AND CO, 1, Whittington Avenue, Leadenhall Street, E.C., Sole Agents for London and District.
Telegraphic Address: "EIRWAL, LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
*** See Advertisement p. 1223 of last week's issue.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for Wet and Dry Gas-Meters, Station Meters, and Governors, Pressure-Gauges, Street Lamps, and Pillars, &c.
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BROTHERTON AND CO., Commercial Buildings, LEEDS.

AGENTS wanted for the Sale of a REGENERATIVE GAS-LAMP; the cheapest in the Market.
Apply to E. & P. Sée, Lille, FRANCE.

TO BE SOLD, for immediate delivery, about 10,000 tons of CANNEL NUTS and 15,000 tons of SLACK. No reasonable offer refused.
Can be seen at DARCY LEVER COLLIERIES, near Bolton, LANCASHIRE.

ENFIELD GAS COMPANY AND TOTTENHAM AND EDMONTON GAS COMPANY.

MR. ALFRED RICHARDS will Sell by AUCTION, at the George Hotel, Enfield Town, on Wednesday evening, Jan. 8, 1890, at Seven o'clock precisely, in convenient Lots, 167 SHARES in the Enfield Gas Company, and £1050 "A" and "B" STOCK in the Tottenham and Edmonton Gas Company.
Particulars may be had of the AUCTIONEER, TOTTENHAM, and 8, NEW BROAD STREET, E.C.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application. Spent Oxide and Sulphate of Ammonia purchased.
120 and 121, NEWGATE STREET, LONDON, E.C.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID for making SULPHATE OF AMMONIA of high quality and colour. *Delivery in Railway Tank-Wagons or Carboys.*
Highest References and all particulars supplied on application.

SULPHATE of Ammonia Lead Work and Fittings. Lead Burner. Tanks and Saturators made and repaired on the shortest notice.
Address F. J. DAVIES, 78, Earl's Court Road, Kensington, LONDON.

BREEZE FURNACES FOR STEAM RAISING AND RETORT FIRING.

MELDRUM BROS. are prepared to fit up their APPARATUS *on approval* to Lancashire, Cornish, and Egg-ended Boilers.
See advertisement on title page last week.
26, Half Street, Cathedral Yard, MANCHESTER.

TO Let, a small Gas-Works. Suitable for a steady working Man with sufficient Capital.
Apply, by letter, to No. 1773, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

Gas Shares (by order of the Executors of the late W. F. London, Esq., and others) in the Romford Gas Company, Lea Bridge Gas Company, and West Ham Gas Company, and offering Investments of a sound and improving character.

MR. ALFRED RICHARDS will Sell by AUCTION, at the Swan Hotel, Broadway, Stratford, on Thursday, Jan. 9, 1890, at Seven o'clock punctually in the evening, 22 £5 SHARES in the ROMFORD GAS COMPANY (Dividends 7 and 10 per cent.), 90 £10 SHARES in the LEA BRIDGE GAS COMPANY (Dividends 10 and 7 per cent.), and 108 £5 SHARES in the WEST HAM GAS COMPANY (Dividends 10 per cent.).
Particulars may be had of the AUCTIONEER, TOTTENHAM, and 8, NEW BROAD STREET, E.C.

Is now Ready, the Fifth Edition of the

HANDBOOK
FOR
Gas Engineers and Managers.

BY
THOMAS NEWBIGGING,

Member of the Institution of Civil Engineers.

The present Edition marks an important advance on those that have gone before. Considerable additions have been made to the text, and much of it has been re-written and otherwise improved. It extends to 524 pages, and contains 193 illustrations.

PRICE: MOROCCO, GILT, 18s.; CLOTH, 15s.; DELIVERED FREE.

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Spontaneous Ignition of Coal.
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Naphthaline.
Exhausters.
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Washers.
Scrubbers.
Bye-Pass Mains and Valves.
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Gasholders.
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Consumers' Gas-Meters.
Testing Meters.
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Bronze for Fittings.
Lacquer and Varnish.
Public Illuminations.
Coloured Fires.
Devices for Illuminations.
Illuminating Power.
Various Standards of Light.
Jet Photometer.
Specific Gravity of Gas.
The Use of Gas for Cooking, Heating, Ventilating, and Motive Power.
The Residual Products.
Applications of Sulphate of Ammonia, &c., in Agriculture.
Coal Products.
Chemical and other Memoranda.
Relative Value of different Illuminating Agents.
Calorific Power of Gases and other Substances.
Specific Heat of Substances.
The Gas Industry of the United Kingdom.
The Capital Employed in Gas-Works.
Sundry Useful Notes.
Co-efficients of the Cost, &c., of the Buildings, Apparatus, Machinery, and Plant of a Gas-Works.
Miscellaneous.
Office Memoranda.
Epitome of Mensuration.
Arithmetical and Algebraical Signs.
Approximate Multipliers for Facilitating Calculations
Table of Diameters, Circumferences, and Areas of Circles, and Sides of Equal Squares.
Weights and Measures.
French Weights and Measures, Decimal System.
Money Tables.
Alphabetical Index.

LONDON:

WALTER KING, "JOURNAL OF GAS LIGHTING," ETC., 11, BOLT COURT, FLEET STREET, E.C.

TO INVESTORS AND CAPITALISTS.

THE KETTERING WATER-WORKS COMPANY.
ISSUE OF NEW ORDINARY SHARES.

MESSRS. ROBINSON & SON are instructed by the Directors to Offer FOR SALE by PUBLIC AUCTION, in Lots, at the Corn Exchange, Kettering, on Friday, Jan. 10, 1890, at Six o'clock in the Evening precisely, pursuant to the provisions of the Kettering Water-Works Act, 1889 (under which all new Shares are to be offered for Sale by Auction or by Tender before being offered to the existing Shareholders), 1000 NEW ORDINARY SHARES of £10 each in the above Company, part of an additional Capital authorized to be raised for the purposes of New Works now in course of construction, and which have been rendered necessary by the constantly increasing demand for the Company's Water, consequent upon the extraordinarily rapid growth of the Population and Industries of the Town.

For information as to the Company's position, its existing and new Works, and the Dividends lately paid on its present Capital, with printed particulars and conditions of the present issue, apply to the AUCTIONEERS; to Messrs. G. & H. LAMB AND STRINGER, Solicitors; or to the SECRETARY of the Company, all of KETTERING.

PRESTWICH COUNTY ASYLUM GAS-WORKS.

TO BOILER MAKERS.
CONTRACT No. 1.

THE Visiting Committee are prepared to receive TENDERS for a STEAM-BOILER, 12 feet long by 4 ft. 6 in. diameter, and Mountings, complete and fixed.

The specification, form of tender, and other particulars may be obtained on application to Mr. Thomas Newbigging, C.E., 5, Norfolk Street, Manchester.

Sealed Tenders, endorsed "Steam-Boiler, Contract No. 1," to be addressed to the Superintendent, County Asylum, Prestwich, Manchester, so as to be delivered not later than Twelve o'clock noon, on Monday, the 13th of January, 1890.

Dec. 23, 1889.

PRESTWICH COUNTY ASYLUM GAS-WORKS

TO GASHOLDER MAKERS.
CONTRACT No. 4.

THE Visiting Committee are prepared to receive TENDERS for the Construction and Erection of an IRON TANK AND GASHOLDER.

The specifications and drawings may be seen, and bill of quantities, and form of tender obtained on application to Mr. Thomas Newbigging, C.E., 5, Norfolk Street, Manchester.

Sealed Tenders, endorsed "Tank and Holder, Contract No. 4," to be addressed to the Superintendent, County Asylum, Prestwich, Manchester, so as to be delivered not later than Twelve o'clock noon, on Monday, the 13th of January, 1890.

Dec. 23, 1889.

HALIFAX CORPORATION GAS-WORKS.

THE Halifax Corporation are prepared to receive TENDERS (*a*) for the supply of SULPHURIC ACID, and (*b*) for the purchase of SPENT OXIDE OF IRON for the year ending the 31st of December, 1890.

Full particulars and form of Tender may be obtained on application to Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.

Sealed tenders, endorsed "Sulphuric Acid" or "Spent Oxide," as the case may be, to be sent to the undersigned not later than Twelve o'clock, on the 15th of January, 1890.

The Corporation do not bind themselves to accept the lowest, highest, or any tender.

By order,
KEIGHLEY WALTON, Town Clerk.

Town Hall, Halifax, Dec. 27, 1889.

COUNTY BOROUGH OF HALIFAX.

THE Gas-Works Committee of the Halifax Corporation are prepared to receive TENDERS for the Supply of WET and DRY METERS and LEAD PIPES required in connection with their Gas-Works during the year ending the 31st of December, 1890.

Full particulars, and Forms of Tender, may be obtained on application to Mr. Thomas Holgate, F.C.S., Gas-Works, Halifax.

Sealed tenders, endorsed "Wet Meters," "Dry Meters," or "Lead Pipes," as the case may be, to be delivered to the undersigned not later than Twelve o'clock at noon, on Wednesday, the 15th of January, 1890.

The Corporation do not bind themselves to accept the lowest, highest, or any tender.

By order,
KEIGHLEY WALTON, Town Clerk.

Town Hall, Halifax, Dec. 27, 1889.

THE Corporation of Middleton are prepared to receive TENDERS for the Supply and Erection of a PLANT for the Manufacture of SULPHATE OF AMMONIA, capable of distilling 20 Tons of Ammoniacal Liquor per day of 24 hours.

Tenders to be delivered at my Office on or before the 6th of January, stating the time with in which the Plant can be erected, and endorsed "Sulphate Plant."

FREDERICK ENTWISTLE,
Town Clerk.

Town Hall, Middleton, near Manchester,
Dec. 23, 1889.

THE Corporation of Middleton are prepared to receive TENDERS for the supply of 3-in., 4-in., and 6-in. CAST-IRON GAS-MAINS.

Further particulars may be obtained from Mr. Hartley, Gas Manager, Middleton.

Tenders, addressed to the Chairman of the Gas Committee, to be delivered at my Office, on or before Wednesday, the 15th of January, 1890, endorsed "Tender for Mains."

The Corporation do not bind themselves to accept the lowest or any tender.

FREDERICK ENTWISTLE,
Town Clerk.

Town Hall, Middleton, near Manchester.
Dec. 24, 1889.

THE Corporation of Middleton are prepared to receive TENDERS for the supply of the SULPHURIC ACID required at their Gas-Works for the Fifteen months ending the 31st of March, 1891.

Further particulars may be obtained from Mr. Hartley, Gas Manager, Middleton.

Tenders, addressed to the Chairman of the Gas Committee, to be delivered at my Office, on or before Wednesday, the 15th of January, 1890, endorsed "Tender for Sulphuric Acid."

The Corporation do not bind themselves to accept the lowest or any tender.

FREDERICK ENTWISTLE,
Town Clerk.

Town Hall, Middleton, near Manchester.
Dec. 24, 1889.

CORPORATION OF LEICESTER.

CAST-IRON PIPE CONTRACT.

THE Gas Committee of the above Corporation are prepared to receive TENDERS for the supply of the necessary CAST-IRON PIPES and CONNECTIONS, from 3 inches to 24 inches in diameter, required during the Twelve months ending the 31st of December, 1890.

Specification and form of tender to be obtained from the Engineer.

Tenders, addressed to Councillor Lennard, Chairman, and endorsed "Tender for Cast-Iron Pipes, &c.," to be delivered at these Offices not later than Eleven o'clock a.m. on Saturday, Jan. 11, 1890, prox.

The Committee do not bind themselves to accept the lowest or any tender.

ALFRED COLSON, M.Inst. C.E.,
Engineer and Manager.

Gas Offices, Millstone Lane, Leicester,
Dec. 18, 1889.

TO GAS ENGINEERS AND MANAGERS.

THE Directors of the Plymouth and Stonehouse Gaslight and Coke Company are desirous of appointing a person as ENGINEER and MANAGER of their Works.

He must have a thorough practical knowledge of the Manufacture and Distribution of Coal Gas; also the Manufacture of Sulphate of Ammonia. Also to design and prepare Plans and Specifications, and carry out any new Works that may be required; and fully competent to undertake and direct the general Superintendence and Management of the Works, and devote the whole of his time and attention to the service of the Company.

The salary will be £350 per annum to commence with.

He will be required to reside on the Works, where a House, with Gas and Coals, will be provided.

Applications, endorsed "Engineer and Manager," stating age, qualifications, and enclosing testimonials as to character and ability, to be sent to the Secretary, on or before the 21st day of January, 1890.

By order,
JNO. THOMAS, Secretary.

Gas Offices, Plymouth Dec. 20, 1889.

RETORTS AND FIRE-BRICKS.

THE Directors of the Rochester, Chatham, and Strood Gaslight Company are prepared to receive TENDERS for the supply of 1500 feet run of CLAY RETORTS, 20,000 FIRE-BRICKS, 100 TILES, and 20 tons of CLAY, according to specification and form of tender, which may be had on application at their Office, 58, High Street, Rochester, where tenders must be delivered before Noon of Thursday, the 2nd of January, 1890.

By order,
WILLIAM SYMS,
Secretary and Engineer.

Dec. 14, 1889.

TO INVENTORS AND PATENTEES.

MR. W. H. BENNETT having had considerable experience in matters connected with Gas, Water, and Sanitary Improvement, begs to that he continues to assist Inventors in the perfection of their designs, and to obtain for them PROVISIONAL PROTECTION, whereby their Inventions may be secured for Twelve months; or LETTERS PATENT, which are granted for Fourteen Years.

Patents completed, or proceeded with at any stage, thereby rendering it unnecessary for persons resident in the country to visit London.

Patents procured for Foreign Countries.

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Price 2s. per dozen, or 10s 6d. per 100, post free.

CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

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A GUIDE TO THE STUDY OF THE

MEASUREMENT OF LIGHT.

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Member of the Society of Public Analysts and of the Committee of the London Section of the Society of Chemical Industry.

Chemist and Superintending Gas Examiner to the London County Council.

The aim of the Author has been to give a comprehensive account of the various methods of Photometry in daily use, and to make the book thoroughly practical by indicating the many precautions necessary for ensuring accurate results in photometrical work. The volume contains chapters on the History and Principles of Photometry; Horizontal, Radial, and Jet Photometers; Standards of Light; the Proposed Substitute for Candles; the Auxiliary Apparatus required in Testing Gas; the Examination and Adjustment of a Gas-Testing Photometer; and Colour and Stellar Photometry; together with an Appendix comprising the Notification of the Metropolitan Gas Referees, Tables for the Correction of Volume of Gas and Observations of Candles, and other matter useful to Photometrists.

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By F. SOUTHWELL CRIPPS, Assoc. M. Inst. C. E.

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CHARLES HUNT, M. Inst. C. E.

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MANUFACTURED BY
JONATHAN WILKINSON, Gas Engineer,
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Instructions are furnished with the Apparatus, which render the manipulation easy, and in the hands of any moderately careful person, will give MORE CORRECT results than can be obtained by any of the expensive, laborious, and intricate processes previously in use.

Apparatus, complete, in polished Mahogany Case lined with Cloth with additional Tests for Lignite, and Sulphuretted Hydrogen Gas, Test Tubes, Box-end Beam, and Glass Scales. £5 10 0

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Price of Single Disc, free by post, 1/7.
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THE ONLY RELIABLE
DRY CENTRE-VALVE.

WORKING ONE, TWO, THREE, OR FOUR PURIFIERS ON AT THE TIME.
ALSO MADE FOR TWO OR THREE PURIFIERS.

No Springing. No Leakage. No Foul Gas passed in Changing. Special Facility for Blowing the Air out of the Fresh Box before putting in Action, without driving it forward into the Holders.
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AUTOMATIC SYSTEM
OF
Charging and Drawing Retorts.

THIS System of automatically Charging and Discharging Retorts without machinery or arduous labour, which is in operation at several places, will shortly be at work in England.

All information as to the advantages, cost, &c., of the System, can be obtained from the undersigned, who will arrange to grant the user for a small Payment per Retort, or a slight Royalty. The System is fully patented; and any infringer will be strictly proceeded against.

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Sole Proprietors of the Largest and Purest Beds of Fire-Clay in England.

FOR GAS FURNACES OUR GANNISTER and SILICA FIRE-BRICKS are acknowledged to be the best and most durable in the market.

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TAR, LIQUOR, AND SPENT OXIDE Purchased for Cash against Delivery.

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FOR GAS AND WATER.
VALVES
FOR GAS, WATER, AND STEAM.

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ANTI-RED LEAD
(SCOLLICK'S PATENT).

This jointing Mastic far supersedes Red and White Lead, and is 30 per cent. cheaper. It has been, and is being supplied to The Gaslight and Coke Company's Beckton, St. Pancras, and Kensal Green Stations; and to show that it gives satisfaction, ten orders have been received from Beckton during this year. Amongst other Works it has been supplied to Vauxhall, South Shields, Sheffield, Maidstone, Walton, &c., &c.

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S. CHANDLER & SONS,
KENNINGTON OVAL.

SULPHURIC ACID.
THOMAS FARMER & Co.
(ESTABLISHED 1778),
The Oldest Manufacturers in the South of England,
Are prepared to supply Gas Companies with SULPHURIC ACID, of first-class quality, and also to treat for the Purchase of their
SULPHATE OF AMMONIA.
Offices: Dunster House, Mark Lane,
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UNEQUALLED.
Gas Companies are solicited to try Samples of the
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Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
MIRFIELD, NORMANTON.

GAS AND WATER PIPES.
1¼ to 12 IN. BORE.

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ALSO MANUFACTURERS OF
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Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

For Prices and complete Analysis, apply to
YOUNG, DANCE, & CO.
COAL OWNERS, NEWCASTLE-ON-TYNE,
Or E. FOSTER & CO. 21, John St., Adelphi, LONDON, W.C.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

GAS COAL.

POPE & PEARSON, LTD.,

have now the authority of several of the most eminent Gas Engineers of London in stating that their Coal yields in practical working over 10,000 cubic feet of gas, with an illuminating power of 16 candles; or by the standard burners now used by the London Gas Companies, an illuminating power equal to 17½ candles.

One ton yields 12½ cwt. of good coke.

This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

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W. G. WALLER & Co.,
RETORT SETTERS & CONTRACTORS,

Having had much experience in the Setting of Retorts beg to call the attention of Gas Engineers and Managers to their Improved System of Setting Retorts and Tar-Furnaces.
Contractors for Building Shafts, Tanks, Retort Benches, and all other Buildings connected with Gas-Works.
Estimates on application.

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THOMAS TURTON AND SONS, LIMITED,
Sheaf & Spring Works,
SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
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JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road, CITY ROAD, LONDON, N.

Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter; and make and erect to order RETORTS, PURIFIERS, and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

FENLONS. PATENT.
THE GREATEST WONDER OF THE AGE.
WARM your CONSERVATORY with our New HOT-WATER APPARATUS, for Gas or Oil, from 20s. Made of Copper or Iron, in any form, for Heating every description of Greenhouse. Portable, easily managed, effective, absolutely safe, and economical.
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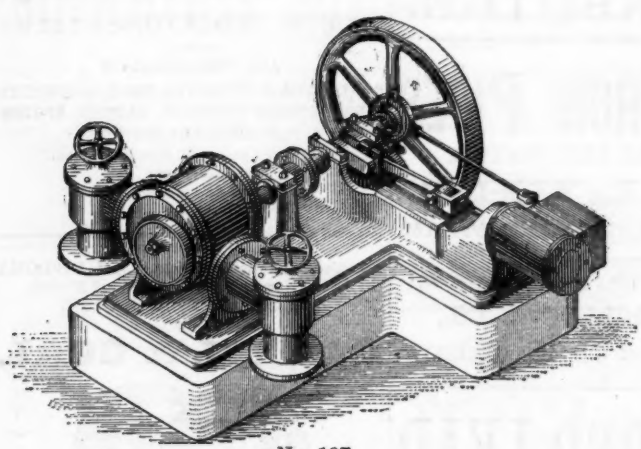
G. WALLER & Co.'s NEW PATENT GAS EXHAUSTER.
MADE WITH 4, 3, OR 2 BLADES.

In use at, or on order for, over 120 *Works, equal to* 6,840,000 *Cubic Feet per Hour.*

Oldest Makers of Beale Exhausters for over 300 Works and 25,600,000 cubic feet per hour.

1,000 to 250,000 CUBIC FEET PER HOUR WITH OR WITHOUT ENGINE COMBINED.



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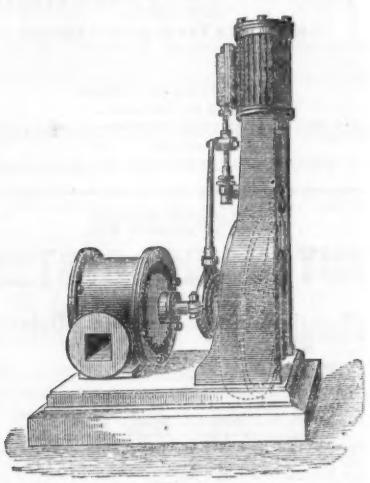

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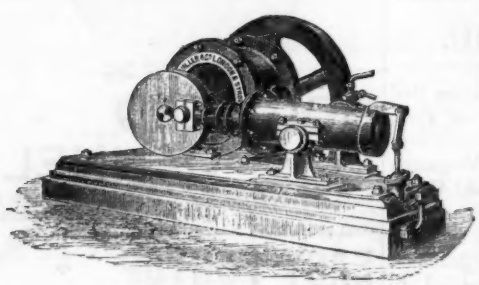

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No. 137.—Horizontal Combined Engine and Exhauster.
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BYE-PASS VALVES.
Disc, Rack, and Screw Valves, Compensating Governors (For Steam Throttle Valves),
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NEAR SOUTHWARK BRIDGE (FOUR MINUTES FROM HOLLAND STREET), AND AT
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PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.

For particulars, price &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.

Prices are Reduced.

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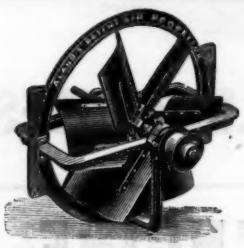

For Ventilating, Heating or Cooling, and for Drying any kind of Material, &c.; for removing foul or heated Air from Engine-Rooms, Factories, Mills, &c.; and for any purpose where a large Volume of Air requires moving at the least expenditure of Power. Cheaper at first cost, and better results obtained over any form of Ventilator in the Market.

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(ROBSON'S PATENT)

Draws the Foul Air from the Top of a Room into the Chimney in a constant stream. Acts with or without Fire Heat. Can be fixed in existing Flues at trifling cost; and is the *only Ventilator* which accelerates the current of Vitiated Air into the Chimney.

Mr. J. H. Cox, jun. (Manager of the Sunderland Gas-Works), writes: "I have tried many and careful experiments with your Ventilator, and find there is always a current of air passing into the chimney, varying, according to the weather, from 20 to 60 cubic feet per minute. I may say your principle is a sound one."

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FOR THE CURE OF STOPPED ASCENSION-PIPES,
A couple of charges of which will clear a stopped pipe, and an occasional charge keeps them clean, and also increases the make per ton and the illuminating power
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TELESCOPIC AND SINGLE-LIFT GASHOLDERS,
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IMPROVED FIXED OR TRAVELLING HYDRAULIC PURIFIER-COVER LIFTERS,
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FACE YOUR RETORT MOUTHPIECES.

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PATENT TWISTED TAPS, DIES, & CUTTERS.

Thousands in constant work, give universal satisfaction.

Work Easier, Less Friction, Last Longer, and do Better Work than straight Grooves.

Main Drilling Stand, with Cup Drills, 1¼ to 6 inch; Taps, Rymers, and Drills.

Ratchet Screwing Stocks, and Adjustable Once-up Stocks, Dies, Guides, &c.

Inquiries and Trial Orders Solicited. Everything Guaranteed. Apply to

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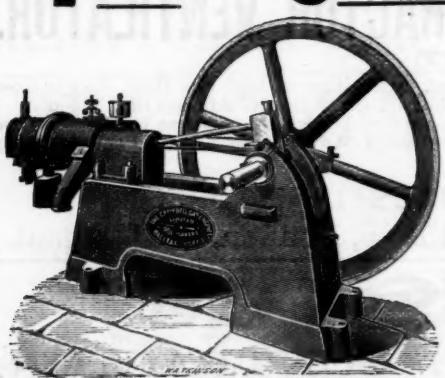
MANUFACTURERS OF EVERY DESCRIPTION OF

IRON OR STEEL LAP-WELDED OR BUTT-WELDED TUBES

FOR ANY PURPOSE.

THE "CAMPBELL" GAS-ENGINE.

GREAT SUCCESS.



Type of 10-HP. Engine Nominal. 25-HP. Indicated.

20 PER CENT. CHEAPER THAN ANY OTHER.

Gives the Highest Satisfaction with all kinds of Work.

Testimonial from Mr. JAMES MOON, Engineer to the Filey Gas-Works.

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GENTLEMEN,—We have been using one of your Gas-Engines on our Works for about four months, and I have pleasure in saying that it does its work in a very satisfactory manner. The engine is half-horse power, steady in all its movements, and, with ordinary care, will drive the exhaust apparatus at an even gauge.—I remain, Yours respectfully,

(Signed) JAMES MOON.

For Price Lists and full particulars, apply to the Sole Makers:

THE CAMPBELL GAS-ENGINE CO., LIMITED,

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SIXTY PER CENT. ECONOMY IN GAS LIGHTING.

The Schülke Regenerative Lamp

FOR

DOMESTIC AND EXTERNAL LIGHTING.

The only Regenerative Lamp employing the Common Flat-Flame Burners.

Lamps giving 20-Candle power consume less than four feet of Gas per hour.

PURE WHITE & PERFECTLY STEADY LIGHT,

NOT AFFECTED BY DRAUGHTS.

Suitable for any existing fittings (Brackets or Suspending).

Can be fixed in a few minutes.

May be seen at the Offices of the

SCHÜLKE GAS-LAMP CO.

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Where Price Lists and full particulars may be obtained.

WATER GAS FUEL GAS

FOR INDUSTRIAL PURPOSES

GENERATED FROM

BITUMINOUS SLACK COAL

BY THE

LOOMIS PROCESS.

The Cheapest Gas-Generating System in the World.

NOVEL IN DESIGN.
MODERN IN CONSTRUCTION.
SIMPLE IN OPERATION.
PERFECT IN RESULTS.

PROCESS AND APPARATUS PATENTED IN ALL COUNTRIES.

By this system more gas, and of a higher heating power per cubic foot, can be generated from a ton of Bituminous Slack Coal than by any other from a ton of Anthracite Coal or Coke.

The successful application of Water Gas for industrial purposes was brought about through this Process at the Works of the—

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Many other industrial establishments in America are successfully using this Process, and a large number of Works are now being erected including a plant at Brussels and at Sheffield (at Messrs. Thomas Firth and Sons, Limited).

This process is especially adapted for firing all classes of Pottery, Tile, and Brick Kilns.

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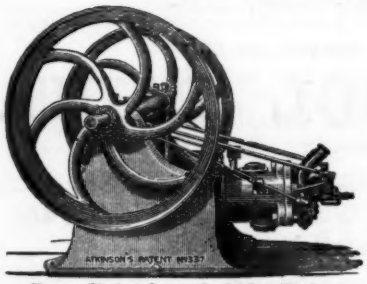

From a Photo. of a nominal 6-h.p. Engine.

ATKINSON'S "CYCLE" PATENT
GAS-ENGINE.

The simplest and most economical Gas-Engine made.

THE BEST ENGINE FOR ELECTRIC LIGHT.

Consumes less Gas per brake horse power than any other Gas-Engine.

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"ROBUS" IMPROVED RETORT SETTINGS, with COKE, TAR, and BREEZE FURNACES.

THE ABOVE SETTINGS & FURNACES ARE PROVING EMINENTLY SATISFACTORY.

Every Particular, with Estimates, forwarded upon Application to

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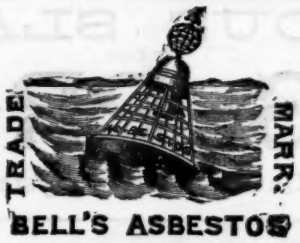

IS MADE READY FOR USE.

IS FIRE RESISTING.
IS WASHABLE.
IS NON-POISONOUS.
IS MANUFACTURED IN ALL USEFUL COLOURS.
IS IMPERVIOUS TO HEAT, COLD, OR WATER.
IS WITHOUT SMELL.

No expensive Oil or Turpentine required.

WILL NEVER BLISTER.

HAS A COVERING CAPACITY 40 PER CENT. GREATER THAN LEAD PAINTS.

For Outside or Inside Work in any Climate.

Bell's Asbestos Aquol Paint is equally suitable for the finest decorative work as well as for general painting. It can be applied over or under any other paint, and, owing to its easy application, can be used with a large distemper brush; the SAVING THUS EFFECTED IN LABOUR BEING **50** PER CENT. OVER THAT OF LEAD PAINTS.

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Those who Study Economy and Protection from Fire should use only

BELL'S ASBESTOS AQUOL PAINT.

BELL'S ASBESTOS AQUOL PRIMING is made Ready for Use.
BELL'S ASBESTOS AQUOL PRIMING stops all suction of Wood, Cement, Plaster, &c.
BELL'S ASBESTOS AQUOL PRIMING should be applied to all New Work.

Suitable for Ceilings, Walls, and New Wood, and is very durable.

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AN EXCELLENT CURE FOR DAMP WALLS.

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Supplied in Casks of 5 to 7 cwt., and Iron Drums of 28, 56, and 112 lbs., Sample Tins of 7 and 14 lbs.

Owing to its Covering Capacity, a SAVING IN FREIGHT of 40 per cent. is effected for a given surface.

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BELL'S ASBESTOS DAGGER PACKING

PATENT No. 15,498.

Every 10 feet has Label as above, and bears our Trade Mark.

Under this registered title are included the inventions of Mr. Field; and experience has proved them to be the MOST EFFICIENT DURABLE, and ECONOMICAL PACKINGS ever made. They constitute such a combination of Asbestos and India-rubber as secures the maximum of elasticity and heat resistance; and they are, therefore, UNEQUALLED FOR EVERY KIND OF ENGINE. These Packings are being universally used by most of the leading Steamship Companies throughout the world for ordinary Compound, Triple, and Quadruple Expansion Engines of the latest types. The packings are composed of rolled Asbestos Cloth, but the India-rubber is placed in two forms to suit various cases.

IN ORDERING STATE WHETHER SQUARE OR ROUND IS REQUIRED.

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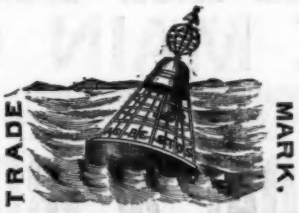

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Is the BEST LOCOMOTIVE PACKING made.

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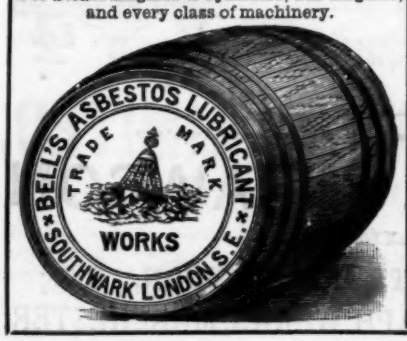
Is specially suited for Hydraulic Machinery, Accumulators, and Ammonia and all Pumps.

BELL'S ASBESTOS LUBRICANT

Is unequalled
For Steam-Engines & Cylinders, Gas-Engines, and every class of machinery.



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The reputation of this Lubricant is based on the experience of thousands of users, which places it far in advance of those who rely only on mere laboratory tests.

ASBESTOLINE IS THE CHEAPEST MOST EFFICIENT, CLEANEST MOST INODOROUS AND SAFEST LUBRICANT.

ASBESTOLINE HAS SAVED 90 PER CENT. OVER OIL. Has been used for all purposes, AND BEATEN ALL OTHER LUBRICANTS IN ACTUAL WORK.

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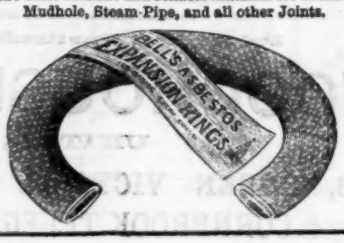
Is the most efficient and reliable Material for Manhole, Mudhole, Steam-Pipe, and all other Joints.



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Will reduce loss by radiation, and saves 40 per cent. of fuel.

Is suitable for Boilers with flat or round bottoms. Is superior to any other, and saves its cost in a few months.

Is sent out dry in bags; therefore cheaper than others sent out wet.

ALL BAGS ARE MARKED AS ABOVE.

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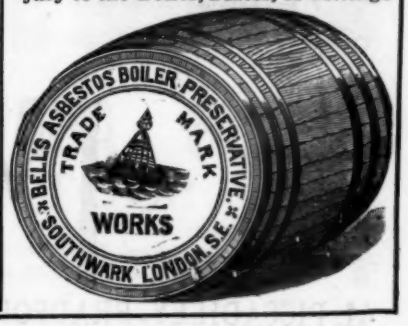
Will effectually keep Boilers clean, and remove any Incrustation, without injury to the Boiler, Plates, or Fittings.



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MANUFACTURERS OF FIRE-BRICKS, LUMPS, TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.
RETORTS CAREFULLY PACKED FOR SHIPMENT.
A STOCK OF DIFFERENT SHAPES ON HAND.

THE THAMES BANK IRON CO.

UPPER GROUND STREET, LONDON, S.E.,
SUPPLY FROM STOCK
CAST-IRON RETORTS
AND ALL KINDS OF GAS-WORKS APPARATUS.
SOCKET-PIPES FOR GAS OR WATER PURPOSES.
FLANGE PIPES FOR STEAM.
Sole Manufacturers of LYON'S 'PATENT' GAS MAIN SYPHONS,
AGENTS FOR
ATTERTON'S PATENT APPARATUS for CHARGING RETORTS.

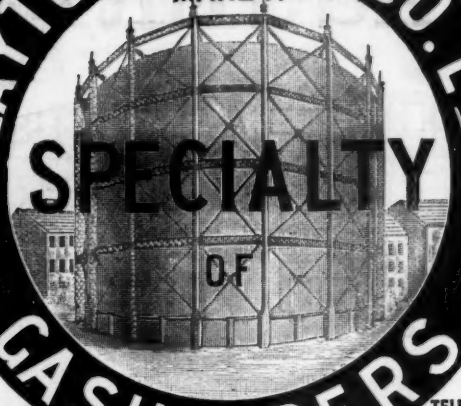
ESTABLISHED MORE THAN A QUARTER OF A CENTURY

WORKS: HUNSLET, LEEDS

LONDON OFFICE: 60, QUEEN VICTORIA STREET E.C.

CLAYTON SON & CO. LTD.

MAKE A SPECIALTY OF GASHOLDERS



AND MAKERS OF GAS PLANT OF EVERY DESCRIPTION.

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JOHN BROWN & CO., LIMITED,

ATLAS STEEL AND IRON WORKS, SHEFFIELD,

ALDWARKE MAIN GAS COAL.

This Coal yields 12,600 feet of 16-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.

THE WIGAN COAL & IRON CO., LIMTD.,

Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

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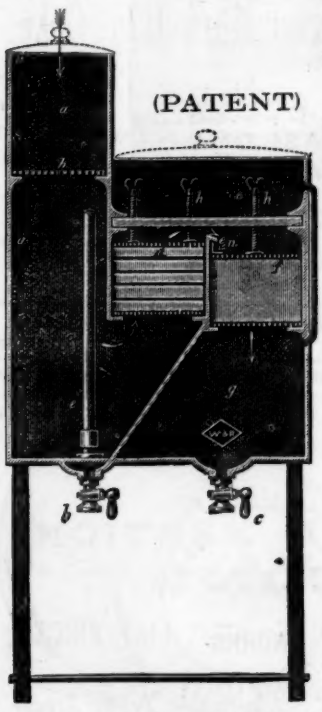

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THE

"Diamond"

Waste Oil Filter

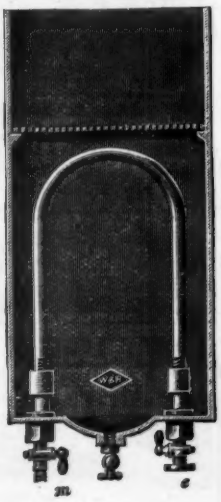
FOR

Purifying Refuse Oil and Grease, in Engine-Rooms, Boiler-Houses, &c.

PAYS FOR ITSELF IN A VERY SHORT TIME.

Used by

Stafford Corporation Gas-Works; L.B. & S.C. Ry. Co., New Cross; Union Bank, Ltd., London; H.H. The Maharajah of Mysore; Plymouth Works; &c., &c.



Prices and Particulars on application to

WOODHOUSE & RAWSON

UNITED, LIMITED,

88, QUEEN VICTORIA STREET, LONDON, E.C.;
41, PICCADILLY, BRADFORD; & CORNBROOK TELEGRAPH WORKS, MANCHESTER.

WILLIAM INGHAM & SONS,

WORTLEY FIRE-CLAY WORKS,
Near LEEDS,

Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing Adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

"THE METEOR."

NEW HIGH-POWER GAS-LAMP,
Westphal's Patent.

Gas Companies should hire these Lamps to their Consumers, and introduce them for Street Lighting as a rival to the Electric Light, as they do not get out of order, are most economical, and the Burner being a circular slit does not choke up.

Particulars and Prices Free.

HENRY GREENE & SONS,
SOLE CONSIGNEES FOR GREAT BRITAIN & COLONIES,
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S. PONTIFEX & CO.,

GAS and WATER ENGINEERS,

Manufacturers of and Contractors for the Maintenance of

PUBLIC LAMPS & LANTERNS:

GLASS—Flint, Opal, and Bent in Stock, and Cut to Sizes.

WELL LAMPS, STREET NAME TABLETS,

LAMP COLUMNS, HEAD IRONS, PUTTYLESS LAMPS,
LANTERN COCKS, REGULATORS,

Improved High-Power Lanterns for Lighting Street Refuges and Open Spaces.

BROWN'S PATENT
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PROPRIETORS AND MANUFACTURERS OF
BOX'S PATENT
PUTTYLESS STREET LAMP.

This Lamp may be supplied fitted with clear opal, or ribbed glass, *as also with enamel tops* if required. The necessary fittings for altering existing Lamps to this system can be supplied at moderate prices.

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Works: 18, STEPHEN STREET, TOTTENHAM COURT ROAD, W.

BRECKENRIDGE CANNEL,

OF KENTUCKY, U.S.A.

The undersigned, SOLE AGENTS for this celebrated Gas Cannel, now offer it for delivery at any port in

GREAT BRITAIN,
ON THE CONTINENT,
OR SOUTH AMERICA.

This Cannel ranks with the Australian Shale as an enricher of Coal Gas; One Gross Ton producing

15,000 Cubic Feet of 50-Candle Gas, & 26 Bushels of superior Marketable Coke.

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JOSEPH CLIFF AND SONS,

THE ORIGINAL (ESTABLISHED 1795). **WORTLEY FIRE-BRICK WORKS,**
NEAR LEEDS.

SPECIAL NOTICE.—Our Patent Machine-Made Retorts have now been thoroughly tested, and have proved themselves infinitely superior to those made by hand. At several large works it has been settled, beyond question, that, owing to the compactness and general excellence, more gas is sent to the gasholder from each ton of coal carbonized than is the case with hand-made Retorts.

AT THE PARIS EXHIBITION, 1878,
THREE MEDALS AND HONOURABLE MENTION
WERE AWARDED TO
JOSEPH CLIFF & SONS,
For their Various Exhibits, amongst which is a
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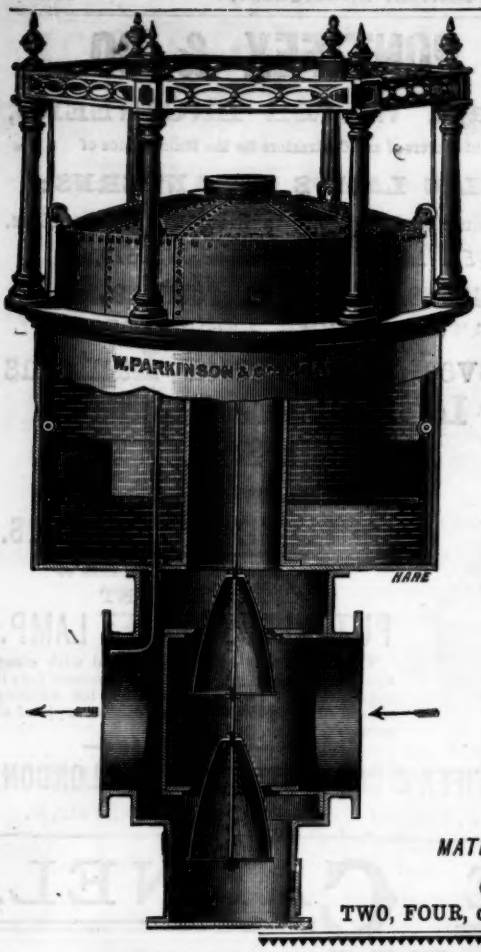
Being the Highest Honour given for this Class.

London Wharf: No. 4, Inside Great Northern Goods Station, King's Cross, N. Liverpool: Leeds Street.



PARKINSON'S
IMPROVED
EQUILIBRIUM ✣ GOVERNOR.

This Governor combines all the advantages of simplicity with perfect efficiency. It effectually overcomes the difficulty of varying pressures experienced by many Engineers owing to the change of light and heavy gasholders, and their causes.

Two parabolic cone valves are employed, one fitted above the other, as shown in the Engraving. By this means the flow of gas is divided, and passes equally through the valves, which are in perfect equilibrium, whatever position they occupy.

No "compensating arrangements" are therefore needed; no attention is required; and the management of the Governor is made as simple as it possibly can be.

In actual practice this Governor is found to be perfect in its action; and every detail in construction is carried out with the utmost care.

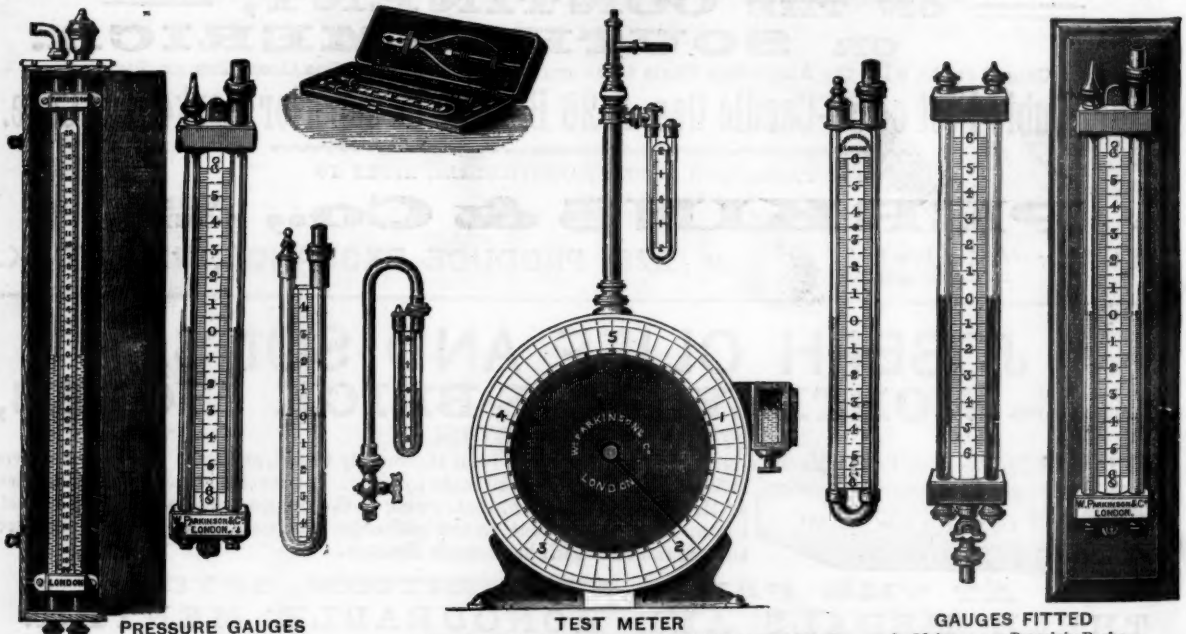
MATERIALS AND WORKMANSHIP OF THE VERY BEST QUALITY.

COUNTERBALANCE or AIR VESSEL, as desired.
TWO, FOUR, or SIX COLUMNS and GIRDERS.—WEIGHTS or WATER PRESSURE.

EXPERIMENTAL APPARATUS.

TEST METERS { For Official Inspectors and others, fitted with Parkinson's Patent Three-partition Drums. A 100-light Meter has recently been made for the City of London Corporation, and Stamped by the Board of Trade as a Standard Instrument.

SULPHUR-TEST METERS, KING'S GAUGES, PHOTOMETERS;
EXPERIMENTAL GOVERNORS AND BURNERS, MINUTE CLOCKS, TWADDEL'S HYDROMETERS, MAIN THERMOMETERS, &c.



PRESSURE GAUGES
In every Size and Style.

TEST METER
For Burners, with Enamel Ring Dial and Slate for marking off. A most useful and necessary Instrument for every Gas Manager.

GAUGES FITTED
On Mahogany or Porcelain Backs or in Polished Wood Cases.

GOLD & SILVER MEDALS, Health Exhibition, London, 1884. SILVER MEDAL, Inventions Exhibition, 1885.

FULL PARTICULARS AND PRICE ON APPLICATION TO

W. PARKINSON & CO., GAS ENGINEERS, COTTAGE LANE WORKS, CITY ROAD, LONDON.

Telegraphic Address: "INDEX LONDON."

[See also Advt., p. 1236.

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